AGRICULTURAL CHEMICALS

A MONTHLY MAGAZINE FOR MANUFACTURERS, PROCESSORS AND DISTRIBUTORS

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AGRICULTURAL INSECTICIDES • FUNGICIDES • STOCK DIPS AND SPRAYS
FUMIGANTS • DAIRY FARM CHEMICALS • WEED CONTROL CHEMICALS • FERTILIZERS
SOIL TREATING MATERIALS • SEED TREATING CHEMICALS • RODENTICIDES

Volume 1 December, 1946 Number 8

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Up to 5% by weight on non-absorptive powders such as talc or pyrophyllite.
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ROTENONE

- The recent removal of price controls on Rotenone products and imports and the consequent impact on the South American arrangements on which supplies have depended have created new uncertainties.
- It is fortunate that imports during the past six months have been heavy and supplies in the hands of processors and insecticide manufacturers are at a higher level than in several years. These supplies, however, fall well short of potential demand though they might go far toward meeting minimum requirements.
- Further substantial amounts of root should be available from South America but the price may be forced up by speculative purchases or foreign bidding.
- It would appear that a situation again has been created which necessitates conservation of Rotenone for the most essential uses and intelligent restraint on the part of all factors responsible for its importation, processing, and distribution to avoid unnecessary or unreasonable price advances and speculative excesses.

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AGRICULTURAL CHEMICALS

THIS MONTH'S COVER

Power shovel loading Caliche (Nitrate Ore) on railway cars at mine in the Ore Pampas of northern Chile. Story of Chilean Nitrate to appear soon in AGRICULTURAL CHEMICALS. (This photo courtesy of Chilean Nitrate Educational Bureau, New York.)

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ALORCO** Cryolite
BLACK LEAF "40" & "155"†
Basic Lead Arsenate
Calcium Arsenate
Paris Green
LORO* Contact Insecticide
ZERLATE* } New Organic
FERMATE* } Fungicides
COPPER-A Compound
SULFORON* } Wettable
SULFORON-X* } Sulfurs
Copper Sulfate (monohydrated)
Copper Sulfate (spray types)
Bordeaux Mixture
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have you tried HEXAETHYL TETRAPHOSPHATE in your insecticidal formulations for aphid and mite control?

With Monsanto's introduction of hexaethyl tetraphosphate to the United States, agriculture has a powerful new weapon for the control of aphids, "red spider" and citrus mites — one that shows great promise against a number of other damaging insect pests in field test now being conducted.

Preliminary tests with hexaethyl tetraphosphate —"HETP"— indicate that it is most effective in emulsion form. Typical emulsions for spraying may be prepared by dissolving HETP in a suitable solvent together with an emulsifying agent. This solution is then added to water to form an emulsion having the proper concentration of HETP. Dilutions of 0.25% to less than 0.025% have been found effective against aphids, "red spider" and citrus mites.

For further information, write: MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second St., St. Louis 4, Mo.

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TABLE OF PROPERTIES

Appearance:	Tan to dark liquid.
Specific Gravity:	Approximately 1.3 to 10.7 lbs./gal.
Crystallizing Point:	Solidifies at approximately minus 40°C.
Boiling Point:	Decomposes above 150°C.
Solubilities:	Miscible in water, acetone, alcohol, benzene, carbon tetrachloride, chloroform, diacetone alcohol, ethyl acetate, glycerine, ortho-dichlorobenzene pine oil, toluene, xylene, alkyl naphthalenes, etc. Not miscible in kerosene or petroleum ether.
Stability:	Tests presently under way indicate that Hexaethyl Tetraphosphate as such is stable, but when diluted in water slowly hydrolyzes. Pending completion of these tests it is recommended that spray solutions be used within four hours after dilution.
Toxicity to Animals:	Preliminary tests on rats indicate that Hexaethyl Tetraphosphate is toxic to warm-blooded animals. Until further information is developed all due precaution should be observed in the application and handling of this chemical and its formulations to avoid skin contact or accidental ingestion.

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Order Early!

EARLY ordering again is vital to insure that agriculture will have enough pest control chemicals for the coming season.

Again the manufacturers are handicapped by shortages of raw materials, containers, and transportation — by blockades beyond their control.

Now, in addition, manufacturers must know whether the customer plans to use established materials or switch to some of the new products.

The Association is receiving the cooperation of State Agricultural Colleges and Experiment Stations in a survey of their 1947 spray-schedule recommendations.

Agricultural Insecticide & Fungicide Association

285 Madison Ave. **New York 17, N. Y.**

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The product we offer is —

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EXCELLENT KNOCKDOWN...HIGHER KILL

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Pyrexcel (finished insecticide)	98%	92%
Official Test Insecticide	99%	50%

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Raw materials to make PYREXCEL are plentiful. Our production facilities assure prompt shipment.

THE EDITOR COMMENTS

A YEAR ago, the belief was common that 1947 would see the end of shortages of all types of agricultural chemicals, fertilizers, insecticides, and others. But, those who know now tell us that shortages in 1947 are likely to be more severe than they were in 1946. The outlook is not encouraging. In urging dealers, mixers and other processors to order their insecticide and fungicide materials early this year, Lea S. Hitchner, secretary of the Agricultural Insecticide & Fungicide Association, points out that in no other way can the industry avoid serious scarcities at crucial points. In other words, the 1947 outlook is far from bright, and if needs are not anticipated so that industry may at least make an attempt to meet them, famine conditions in some products are likely to develop.

Because of circumstances over the years, last-minute ordering of fungicides and insecticides has been common. Fertilizer materials have not suffered too much from this difficulty. But to wait until the emergency is at hand and then to call on the insecticide manufacturer for fast delivery has been the habit of years. Naturally, dealers and distributors are not anxious to stock specialties which may be carried over until the next season. And, naturally, they would rather wait for some assurance of demand. This year, however, there can be no waiting, especially in ordering the standard items. Those who wait may find themselves shut off from supplies with serious crop losses in their territories.

COINCIDENT with the lifting of OPA price controls last month came the end of rotenone shipments from South America at the old prices. Notwithstanding the one-year agreement with the Peruvian Government by American importers, the market in Peru was thrown open to new offers at higher prices. The Peruvians, by tossing the price agreement overboard, have in effect served notice that they will hereafter sell to the highest bidders. That this might conceivably force rotenone prices skyward to unreasonable levels is quite obvious.

In fairness to the Peruvians, however, it should be made clear that their exportable surplus of eight million pounds of root, the agreed-upon quantity, had already been shipped at the set price. Accordingly, it would seem that they are fully within their rights to hold the balance of their supplies for such higher prices as they may obtain in the world markets.

Supply of rotenone now in the hands of American processors is comparatively large, but withal far from adequate for 1947 needs. Hope has been expressed that further shipments may reach the U. S. early next year. In any event, however, the situation could become critical and prices are faced with serious inflation. Obviously, conservation of present supplies is necessary until the situation is clarified.

CAME the coal strike in late November disrupting the carefully laid plans of manufacturers and suppliers of chemicals for agriculture, as well as those of industry in general, and adding gloom to an already dark supply situation. Days lost in vital production of agricultural chemicals at this point can never be made up in time for the 1947 season, a condition accentuated by generally small carry-overs from 1946.

The chemical industry had not at the time of the beginning of this latest strike recovered from the effects of the strike earlier this year. Stockpiles of chemical raw materials had never had a chance to catch up. Accordingly, the latest strike caught chemical production in the worst possible position. That the full effects of this new strike will be felt for the better part of 1947 is the view of industry production experts. The effects are already being felt, but their full force will probably come a few months hence.

Guest Editorial written especially for this issue of Agricultural Chemicals.

Wealth of information available for agriculture

By J. S. Jones
Chemist, Department of Chemistry
Oregon Agricultural Experiment Station, Corvallis

THE systematic survey classification and mapping of predominant soil areas in all parts of the nation during the last half century ranks high with other outstanding achievements in American agriculture. That work was initiated by the Bureau of Chemistry and Soils of the United States Department of Agriculture and was participated in quite generally by the state agricultural college and experiment station organizations. Thanks to this activity, soil sampling today for either chemical or mechanical analysis can be placed on a truly scientific basis. Soil samples systematically taken now in any agricultural area are promptly identified as to geological origin and mechanical makeup by reference to the soil maps of the areas represented. Those maps have been compiled with the greatest of care by the Bureau and its cooperating agencies in the several states and are readily available for either a hasty examination or more detailed study.

In common use now by owners of farmlands and agencies of all kinds for soil description are the names of soil series and types within each series. For example, one might note on a soil map of Oregon the name Willamette silt loam; for one in Washington, Walla Walla silty clay loam; in Idaho, Ritzville loam; in Indiana, Miami silt loam; in Kentucky, Hagerstown clay loam; and in Virginia, Northrup sandy loam. It will be found too that quite systematically each type is characterized further by definite chemical properties for in following up the work of soil survey parties those properties too have been determined with exactness and recorded by soil physicists and chemists for both public and private convenience. The soil maps of any surveyed agricultural area throughout the land condense and make available for various uses a mass of practical information that might in any other form prove to be less understandable and therefore of lessened value to those whose interests they are intended primarily to serve. Soil maps now are available generally for consultation in county agricultural agent offices. In any surveyed and mapped area the farmers there are generally aware of its completion for it might well be that many were called upon during the survey for such pertinent soil facts for the record as actual farming experience could most reliably give. Farmers generally have

(Turn to Page 64)

New Equipment for Agricultural Pest Control

By O. C. French

Division of Agricultural Engineering,
University of California

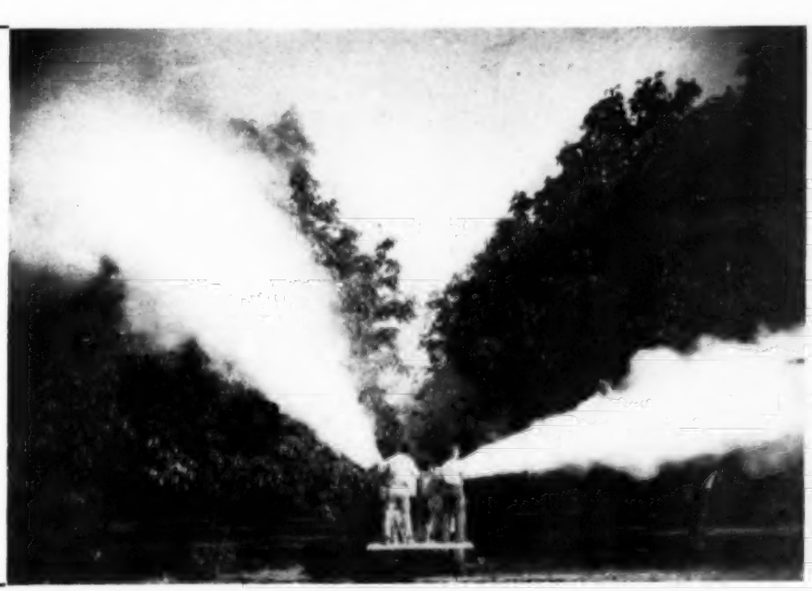
RESEARCH in the field of pest control has in the past been carried on primarily by entomologists, pathologists and horticultural specialists. We are beginning to realize now that these scientists have more than they can handle and that the field of pest control is so broad that all branches of science must cooperate in an effort to solve many of the complex problems of the Agricultural Industry. Even yet most Land Grant Institutions have not met the problem with enough vigor and cooperative effort. Too often the pest control research project is a "one man" project.

When one mentions pest control he may be thinking in terms of controlling insects or diseases on fruits, nuts, vines, truck crops, and vegetables, or weeds in crops or noncultivated areas, soil insects or organisms, insects relative to human health safety, or cattle insects and parasites, rodent control, and many others. Today, when a farm operator is faced with increased labor costs, he immediately seeks power-operated equipment which will do his job satisfactorily with less labor. It is not to be inferred that the engineer has the solution to all pest control equipment problems, but it is evident that more agricultural engineers should consider pest control as a major field of endeavor, and not merely one in which casual effort is sufficient. The annual tax to agriculture because of losses due to pests, and because of the cost of control measures, amounts to many billions of dollars. This figure can and must be reduced.

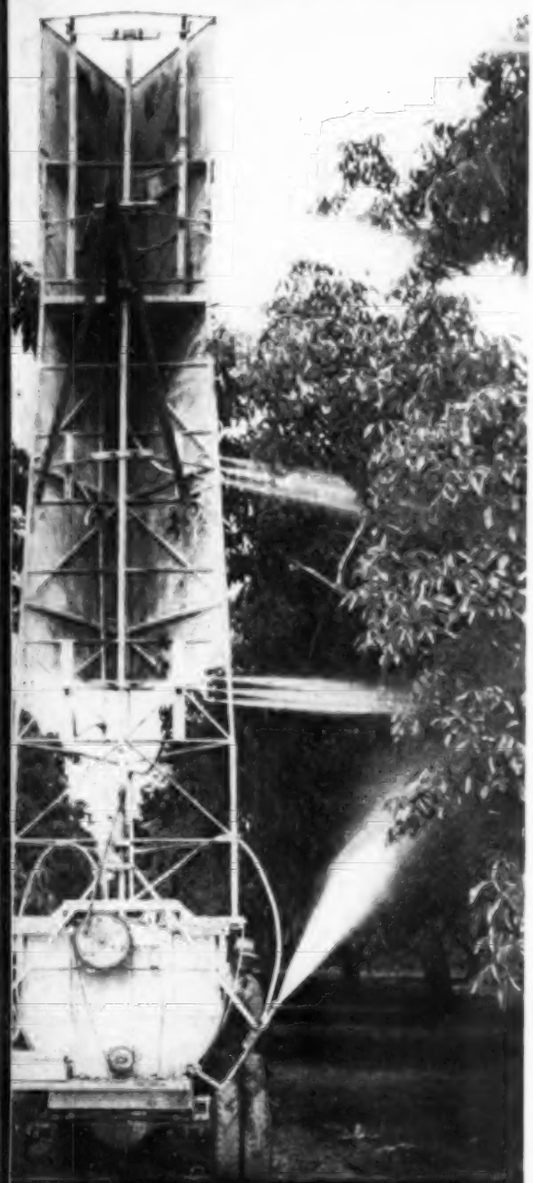
Discussion herewith is limited to some of the more recent items of equipment for applying (1) insecticides and fungicides, (2) chemicals for weed control, (3) soil fumigants and (4) sprays on livestock.

Sprayers for Insecticides and Fungicides

DURING the past decade there has been a decided change in sprayers for applying standard materials on fruit and nut crops. We have witnessed a steady improvement in sprayers, pumps, and engines. Pump pressures have been increased from 400 psi to 600 and 800 psi. Sprayer-tank sizes have been increased and most



Large duster in action on walnut trees. The fan for this unit furnishes 16,000 CFM of air at a velocity of 65 MPH from the 16-inch diameter hand-operated nozzles.



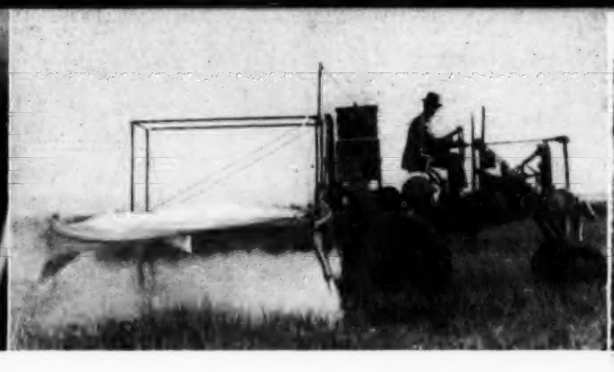
tanks are now constructed of steel rather than wood.

Even prior to World War II there was a notable swing to sprayers operating "on the run" with spraymen riding the sprayer on platforms or in elevated towers. The reason for this procedure was to reduce the labor requirement and also speed up the spray operation. During the war the shortage of labor forced many operators to build automatic vertical booms for their large sprayers. The demand for this equipment came particularly from walnut and citrus growers. At the present time there is no standardized design for these booms. In general these booms consist of a vertical mast mounted at the rear of the sprayer and having a series of mechanically oscillated short spray guns spaced along the mast. For large walnut trees, pumps capable of delivering 80 GPM may be required. To operate these large sprayers efficiently, it is necessary also to have "nurse trucks," equipped with large volume pumps for quickly refilling the sprayer tank.

Concentrated liquid sprayers utilizing a large volume air stream for atomizing and conveying the liquid spray have been in use in California for at least fifteen years. The extent of their use however, has greatly increased during the recent war years. For tree crops, this equipment generally consists of a blower which discharges from 8,000 to 10,000 CFM of air through a fish tail nozzle at velocities of from 120 to 150 mph. Liquid is introduced by nozzles or orifices in a small tube along the length of the fish tail at its outlet. The spray material is concentrated so that usually from 10 to 30 gallons per acre applied to normal sized trees is comparable to from 3 to 6 gallons per tree of standard dilute sprays. This type of equipment has several advantages: it is lighter in weight than the standard sprayer; less time is lost on account of refills; it is operated by only one man, and this same equipment can be used for applying dry dusts. It is not uncommon now to find growers using this equipment to care for the complete spray program on almonds, apricots, peaches, plums, and to a limited extent on pears. Similar equipment has been used for grapes in California for many years.

"Speed Sprayers" Popular

CONSIDERABLE publicity has been given "speed sprayers" during the past few years. Impetus for their use has come about through the necessity for growers to reduce spraying costs. This equipment also uses the principle of a large volume air-blast to atomize and convey spray droplets. In this case a propeller fan is used to furnish the air blast. A four bladed 48 inch propeller directly connected to an engine of from 80 to 100 HP size is used. When turning 2200 RPM this fan will discharge approximately 80,000 to 90,000 CFM. Liquid delivered by a low pressure centrifugal pump is introduced into the air stream through a large number of nozzles located around the air blast exit. As originally built, this sprayer had a series of movable deflector blades at the air exit in order to control the direction of the air stream. This deflector mechanism obviously interfered with the free movement of the air stream. Recent modification of the air discharge throat on this equipment provides for the air blast to be directed outward at 90 degrees from the fan shaft axis and throughout 240 degrees of a complete circle; no provision for changing the direction of the air stream is provided. This modifica-



tion has increased the efficiency of the fan and the resulting spray pattern will carry a considerably greater distance.

One of our large deciduous orchardists has used speed sprayers for the past two seasons and his records show total spraying costs have been reduced to less than 50% of the former method using high pressure sprayers with hand-operated nozzles. Each machine is able to apply spray at the rate of 2500 gallons per hour over a ten hour day.

The speed sprayer is not a machine for small growers, but it is practical for the large orchardist or for commercial pest control operators. Present trends point to a rapidly expanding field for commercial pest control operations.

Airplanes have been used to a limited extent for applying liquid insecticides and fungicides in California for many years. Dormant oil or fungicides in oil have been the principle materials applied by planes. However, with the development of DDT and other new materials, we are now experiencing much demand for airplane application development. Crop treatment requires a completely different aircraft design from the ships used by armed services for DDT distribution. At present no one appears to have a monopoly on the correct equipment for airplane spraying. It is a relatively new field to explore.

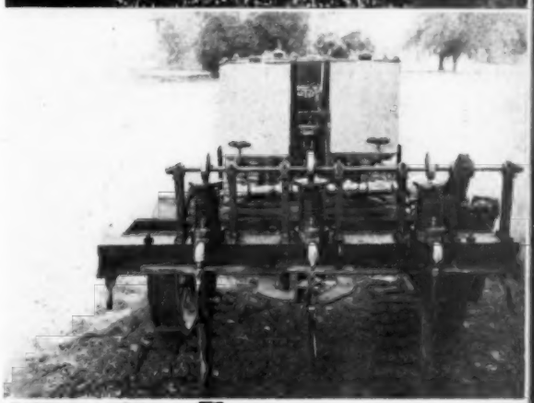
Dusting Equipment

DUSTING equipment has been undergoing a process of redesign and development similar to that of sprayers. With the development of new insecticides have come demands for large volume dusters. No longer can the volatility of a material be considered a substitute for poor dust distribution. With modern dusters increasing both in number and in size as well as in use, we are constantly faced with the difficulty of confining poisonous dusts to fields or crops being treated. The problem of dust drift is causing research workers to give more consideration to concentrated liquid sprays and combination dusters which also apply a finely atomized liquid simultaneously with the dust in order to prevent drifting as well as to increase the dust deposit onto plant surfaces.

The same urgent criterion for duster design is that they, like sprayers, be as nearly "one-man" operated as possible. In general, this requirement has been met in most dusters except for machines dusting very large trees such as walnuts. For these, two operators are generally required in addition to a truck driver.

Experimental work is in progress at the University of California on developing equipment to spray tomatoes with concentrated liquid sprays containing calcium arsenate. Both airplanes and ground sprayers have been used during the past summer. The material has been applied at rates of from 5 to 11 gallons per acre, each gallon of liquid containing three pounds of calcium arsenate. Results showing efficiency of control are not yet available but if satisfactory control is achieved, then aircraft operators will have an expanded field ahead of them.

Vineyard dusting now calls for equipment to handle several other materials besides sulfur. For example the use of dinitro dusts for red spider control calls for a duster which will force this non-volatile material completely into and over all parts of grape vines. The old style sulfur duster is unable to do this. A large volume, low



An airplane adapted for applying liquid herbicides. Outlets to each nozzle along the boom are equipped with spring loaded shut off valves. Pilot can actuate all valves by means of a single cable control. A centrifugal pump, driven by small 4-bladed propeller, can be seen between landing gear. Pump revolves at high speed in flight.

velocity type fan, similar to the citrus duster but of a smaller size, has been developed to meet this need. These dusters are mounted on automobile chassis with reduced wheelbase and tread in order to pass between grape rows without injuring vines.

Truck crop dusters in many cases have to be mounted on specially built tractors in order to provide necessary clearance for crops such as tomatoes. Dusters for truck crops should be integrally mounted on a tractor unit. Trailed equipment has proved too unwieldy for most operations.

Weed Control Equipment

OF all agricultural pests, weeds probably cause greater financial losses than all other pests combined. What are farmers doing to combat this situation? Some, of course, look upon the matter with more or less apathy, but others are fighting the battle against weeds with modern chemical tools. The development of selective herbicides has been one of the greatest advances for agriculture during the past 15 years.

Chemical sprays are now used for several different kinds of weed problems, the more important of which are:

(1) Pre-emergence sprays, primarily oil, on planted fields before the crop emerges.

(2) Oil sprays for killing weeds in young carrots and similar crops.

(3) Selective sprays such as "Sinox" and 2,4-D to kill weeds in grain, flax, peas and certain truck crops, principally onions.

(4) General weed control such as along fence lines, irrigation ditches, summer fallow fields, etc.

Equipment for applying these chemical sprays is far from being standardized, but there are certain specifications which can be stated to assist in the construction of such sprayers.

Pump, Tank, Boom, Nozzle

ANY type of pump may be used providing it will deliver the required volume at a pressure of approximately 100 psi. High pressure pumps are not necessary and are usually more expensive than rotary, centrifugal or turbine type pumps. Rotary pumps are satisfactory for oil sprays but do not give good service for water sprays which usually contain abrasives. Single stage centrifugal pumps in the 3600 RPM class are being used on many sprayers. Some weed sprayers, particularly for oil, use an air compressor and a pressure tight tank for the spray solution. These units are limited to rather small sprayers having booms with approximately 8 nozzles.

Chemical sprayer tanks should be of metal since these are easier to clean and maintain. The size of tank will depend upon the pump capacity and length of boom. For example, a field sprayer with a 50 foot boom and 60 GPM pump might well have a 1000 gallon tank if water is not easily accessible. All tanks should be equipped with some means of agitation such as paddles or liquid recirculation. All spray solutions do not require agitation but the versatility of the sprayer will be increased if agitation is provided.

In general, booms should be constructed with pipe not smaller than one inch. Pipe smaller than one-inch is difficult to tap in order to install the spray nozzles. Booms are frequently made in three sections, the two end sections being hinged to permit folding in for transportation or passing through gates. The side sections should be supported both vertically and horizontally to prevent whipping. For large field sprayers it is frequently desirable to use tiller wheels at the ends of the side sections of the boom. These wheels not only support the boom but also serve as markers for the tractor driver. For spraying such materials as 2,4-D which leaves no visual trace on plants, a marker is highly essential. In practically all cases the boom should be constructed so as to be adjustable vertically.

Nozzles which deliver a flat, fan-shaped spray are preferred for weed sprayers. Spacing of the nozzles on the boom will depend on whether row-crops or field spraying is being designed for. For field spraying the nozzles should be spaced so that either the spray fans just meet, or so that alternate fans meet, which gives double coverage.

An increasing use of airplanes for spraying selective herbicides has

occurred in California during the past year. Whether applying 2,4-D or "Sinox" the general procedure is to prepare a mix such that the desired amount of toxic material per acre is mixed with from 12 to 15 gallons of water. Results have been generally satisfactory with this concentrated mix. A substantial amount of rice in California was sprayed with 2,4-D by airplanes this past summer. Excellent control of the pond lily was obtained by this procedure.

Most of the planes for this work have been of the M3N, Stearman, or Travelaire makes. Several systems are in use for atomizing and distributing the liquid from planes but two devices predominate, namely: (1) a boom mounted under the lower wing and extending nearly the entire wing length. Centrifugal or rotary type pumps driven by a small auxiliary propeller furnishes the boom and nozzles with liquid at pressures from 20 to 85 psi. (2) Rotating brushes or spinners similar to a centrifugal pump impeller. Usually two of these devices are attached to the underside of the lower wing on both sides of the fuselage. Auxiliary propellers drive individual pumps for each unit.

It is essential that quick acting shut off valves be provided close to each nozzle or atomizing device, in order to prevent spraying on adjacent fields while turning. For most uses of the planes observed applying liquids, a swath width of 40 feet or less must be expected for flying altitudes of from 6 to 15 feet. More uniform spray distribution has been obtained when flying 15 feet rather than at lesser elevations.

Soil Sterilant Distributors

For certain non-cultivated areas such as ditch banks, fence lines, fire breaks, court-yards and playgrounds it may be desirable to apply a chemical which will sterilize the soil for several years and thus prevent all vegetative growth. Such materials as Arsenicals, Sodium Chlorate, and Borates have been used a great deal for this purpose. They can be applied in dry form by means of broadcast spreaders as well as by means of sprayers. A small wheel-barrow or cart-type fertilizer spreader has been used fairly satisfactorily for dry application of sterilants.

A portable livestock spray-chute. The chute is built on a two-wheel trailer. Cattle can be completely sprayed at the rate of over 2 head per minute. (Photo courtesy Wm. Abildgaard.)

Dusters

With the increasing interest and use of 2,4-D there has been consideration and some experimentation of applying 2,4-D as a dust and allowing it to go into solution on the plant surface with dew or rain. In many areas such as the middle western wheat and corn belt an adequate supply of water to keep spray rigs running is a serious problem. It may well be that further experimentation will prove that selective herbicides may be applied in dry form. One hazard will be involved, that of the dust drifting onto adjacent fields.

Burners

Control of weeds in irrigation and drainage ditches by burning has been practiced by many irrigation districts in California. For this work, long booms are attached to a tractor which travels along the berm of the ditch. Along the boom and directly over the ditch, are spray nozzles to which oil under 75 to 100 psi is supplied. The atomized oil is ignited and the machine travels along at from 1 to 1½ miles per hour. No effort is made to secure complete combustion of the atomized oil, in fact a great deal of oil remains on the unburned plant surface. A few days after burning, the green plants will dry up and a second burning will clean up the ditch quite well. Very little field burning has been practiced in California although some work has been done this year with flame cultivation of cotton. For several reasons this practice has not been nearly as successful in California as has been the case in some of the southern states.

Soil Fumigant Equipment

THE soil fumigant, carbon disulfide, has been used for many years for killing weeds, certain soil organisms, and for wire worms and nematodes. During recent years, new materials, particularly Ethyl DiBromide and "DD" for wireworm and nematode control, have come into practical use.

Power equipment is available to a limited extent for injecting these materials into the soil. Usually this work is done under a contract agreement. Briefly, the machines for intro-

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Two Experts Discuss the . . .

Fertilizer Situation

The WORLD Outlook

By Dr. Oliver E. Overseth*

Secretary, Committee on Fertilizers, International Emergency Food Council, Food and Agricultural Organization of the United Nations, Washington, D. C.

DURING the war, three countries, the United Kingdom, Canada and the United States were members of the Committee on Fertilizers of the Combined Food Board. Several months following the end of the war, the Combined Food Board ceased operations (June, 1946), and the International Emergency Food Council took over its duties. The Committee increased its membership to include Belgium, Chile, Denmark, France, India, the Netherlands, Norway, and a joint membership for Australia and New Zealand. Included with attendance at all meetings are representatives of Food and Agriculture Organization and the U.N.R.R.A.

The following information on the world fertilizer output, while presented with the authorization of the Committee on Fertilizers, represents the personal view of the speaker.

In spite of the devastating effects of the Second World War, the world production of commercial fertilizers has increased from 7,600,000 to 9,324,000 metric tons actual nitrogen, P_2O_5, and K_2O.[1] While nitrogen production has decreased in Japan and continental Europe, it has increased in North America and Great Britain. Although the phosphate rock from Ocean and Nauru Islands has been greatly reduced, the supplies available for world distribution from the United States and French North Africa have greatly increased. German potash is recovering from war disruption and the supplies in France and the United States have greatly increased over wartime and pre-war production. In spite of these increases there is a significant and critical shortage of all fertilizer materials today.

We will now briefly examine the extent of the shortage of nitrogen, phosphates, and potash.

Nitrogen

THE world shortage of nitrogen is much more serious than the shortage of any other plant nutrient. From stated requirements as submitted by over 100 countries, the world shortage of nitrogen is about 30% or approximately 842,000 metric tons, equivalent to nearly 4,200,000 tons ammonium sulfate. Minimum requirements for Germany, Japan and South Korea are included in the figures.

This shortage, while affecting all countries, is especially acute in continental Europe, Asia and the Far East. It is in some of these countries where fertilizers have been relied on to produce minimum supplies of foodstuffs essential to prevent actual starvation, that food shortages are severe.

In Asia and the Far East comparatively small quantities of commercial fertilizers have been used in the past. Japan has been the leader in consumption of nitrogen and phosphates and accounts for about 80% of the amount used. China and Formosa have used small quantities but are awaking to the importance of fertilizers in their food economy and present important markets. India considers that large quantities of commercial fertilizers would alleviate the acute food shortage position and with large areas of irrigated lands in rice she could reduce the starvation of millions of her population.

With hand labor and intensive

(*Turn to Page* 22)

* Talk presented Nov. 13 at National Fertilizer Ass'n. Convention, Atlanta, Ga.

[1] Because of the lack of available information the world figures do not include USSR.

The authors, L. G. Porter (left) and Dr. O. E. Overseth (right) study some notes at the recent convention of the National Fertilizer Association, Atlanta, Georgia.

The DOMESTIC Outlook

By L. G. Porter

Chief, Fertilizer Division, Materials & Equipment Branch, Production and Marketing Administration, U. S. Department of Agriculture

DISCUSSING the outlook for nitrogen, phosphate, and potash for domestic agriculture during the current season, it seems logical to devote a major portion of the consideration to the nitrogen picture since it is more complex and confused. However, before getting into the subject of nitrogen, it is well to consider briefly the phosphate and potash situation.

For the 1946-47 season the United States supply of soluble phosphates, as agreed to within the International Emergency Food Council, compared with the 1945-46 program is as follows:

Phosphate Supplies in Short Tons of P_2O_5

	1945-46 *Program*	1946-47 *Program*
U.S. Production ...	1,430,000	1,554,000
Imports		
Canada	30,000	27,300
Total U.S. Supply..	1,460,000	1,581,300
Exports Approved by Combined Food Board	55,000	56,800
Net Supply for U.S. & Possessions ...	1,405,000	1,525,500

Export Allocations for 1946-47 *Phosphates*

	Tons
Canada	26,400
Iceland	200
Kenya	1,400
Philippines	1,700
British W. Indies....	700
UNRRA Countries ..	5,500
Latin-American Republics	20,900
	56,800

Currently, production of normal superphosphate is running about 2 to 3 per cent behind schedule, due largely to box car shortages at the mines and an inadequate supply of sulfuric acid in the Southeast. (We are happy to report that the negotiations for the lease of the sulfuric acid plant at Alabama Ordnance Works are near consummation and are hopeful that acid from the plant can be expected to move within the near future.) A recent review of the soluble phosphate situation gave no grounds at the present time for a revision of the preliminary estimate of production for the current season.

You are all familiar with the score on potash. According to a recent release of the Civilian Production Administration, allocation of the 795,880 tons of domestic potash (K_2O) available for distribution from June 1, 1946 through March 31, 1947 (Period Eight) has been completed with the apportionment of 35,606 tons to new or expanded fertilizer plants and a supplementary allotment of 7,566 tons to established Midwestern plants.

The allocation of potash, suspended September 30, 1945, was resumed June 1, under Schedule 120 of Order M-300. Distribution of the total domestic potash supply for Period Eight was as follows:

	Tons (K_2O)
Industrial or chemical	**65,835**
Exports (other than Canada)	**14,778**
Canada	**35,929**
U. S. Agriculture (fertilizer)	**679,338**
Total	**795,880**

Exports of domestic potash approved by the Internation Emergency

Food Council during the current season total 56,100 tons of K_2O as compared with about 64,000 tons last season. By countries the 1946-47 exports are as follows:

Export Allocations for 1946-47 U. S. Potash

	Tons
Canada	40,900
British West Indies	2,800
New Zealand	1,600
Philippines	200
Latin American Republics	10,600
Total	56,100

The Nitrogen Picture

WHILE the United States was originally scheduled to obtain about 680,000 tons of nitrogen for agricultural use in 1946-47, a figure approximately the level of the 1945-46 program, recent developments have materially altered the outlook on the basis of estimates made about 10 days ago, at which time a cut-back of about 30,000 tons of nitrogen appeared likely. However, since that time, export commitments originally set at 97,000 tons of nitrogen have been reduced to 67,000 tons of nitrogen. The decrease of about 30,000 tons of N from the earlier estimates is a result of curtailed production of synthetic nitrate of soda, a small cut-back in fertilizer grade urea, in part compensated by an increase in the amount of nitrogen expected to be available in the form of solutions. A break-down of the now estimated supply by major groups of material and the distribution in tentative form is as follows:

Nitrogen Supplies (in Short Tons)

	1946-47 Program
U. S. Production	
Ammonium Sulfate	143,500
Nitrogen Solutions	195,000
Ammonium Nitrate	159,500
Other Nitrogen Compounds	26,000
Organics	30,000
Domestic Production	554,000
Imports	
Chile	
Sodium Nitrate	88,000
Canada	
Ammonium Sulfate	23,600
Cyanamid	27,300
11-48 Ammo Phos	2,400
16-20 Ammo Phos	11,500
Ammonium Nitrate	38,000
Norway	
Calcium Nitrate	1,100
Total Imports	191,900
Total U. S. Supply	745,900
Exports Approved by I.E.M.C.	67,000
Net Supply for U. S. & Possessions	678,900

Nitrogen supply figures do not include materials which the War Department will produce at Ordnance Plants now being reactivated, for shipment to occupied areas of Japan, South Korea and Germany.

Scheduled imports of Chilean nitrate of soda for six months ending Dec. 31, 1946, are approximately one-third of indicated total for 1946-47 season.

This has brought us up to the Army fertilizer program, which in the United States represents the production of ammonium nitrate for shipment to U.S. occupied zones of Japan, Korea, and Germany. For this program, which envisions the production of 684,000 short tons of material by next August, the Army has reactivated Cactus, Missouri, Morgantown, and Ohio River ammonia plants. Ammonium nitrate solution will be made at the Holston, Indiana, Kankakee, Radford, Sunflower, and Wabash River Ordnance Works. Grained material will be made at the Cornhusker, Illinois, Iowa, Milan, Nebraska, and Ravenna graining plants.

Pending the time these plants in the Army program start operating, the Army is borrowing ammonium nitrate from the domestic commercial supply. For the months of August, September, October, and November this take comprises about 100,000 tons of material.

The Secretary of Agriculture was informed by the Secretary of War, under date of October 16, that as of that date the War Department envisions no major difficulty in replacing the borrowed tonnage according to schedule. The War Department estimates that production of finished fertilizer grade ammonium nitrate will be 30,000 tons in November; 50,000 tons in December; 75,000 tons in January; 84,000 tons in February; and reaching 88,000 tons per month for March and subsequent months. Now for the sad news. All of the ammonium nitrate to be returned by the Army is scheduled for export during January through April. In addition, 8,000 tons of the domestic supply is scheduled for movement to Puerto Rico. For April through June all but 10,000 tons of ammonium nitrate supply will be retained for U. S. consumption.

One of the most difficult problems involved in the Army program has been that of tank cars for anhydrous ammonia and ammonium nitrate solutions. It was first proposed that the entire fleet of Army-owned tank cars of this type under lease to private operators would be recalled, but through the efforts of the Dept. of Agriculture, the Civilian Production Administration and others interested, a plan was worked out which reduced the withdrawal of Army-owned cars and made possible the set-aside of tank cars for the proposed operations at Alabama Ordnance Works.

A survey is now being made by the Department of Agriculture to determine in as realistic a manner as possible the probable demand for nitrogen, phosphates and potash for the next several years. This survey will provide a basis for a re-appraisal of production capacity requirements in these several fields.

The fertilizer industry has done a good job under most difficult circumstances during the war years and subsequently. We in the Department appreciate the fine spirit of cooperation which the industry has accorded us. This spirit we are sure will prevail in future years. ★★

WORLD FERTILIZER

(*Continued from Page* 20)

cultivation on limited land resources, a unit of fertilizer produced more actual food for direct consumption than in many other parts of the world.

In comparison with prewar production of nitrogen, with the exception of continental Europe, there has been an increase in the output of nitrogen for fertilizer use. The Western Hemisphere has substantially increased its nitrogen production, as is

also true of the United Kingdom. The decrease in continental European production of about 290,000 metric tons nitrogen still leaves the world with a net increased output estimated at 227,000 tons of nitrogen for the current fertilizer year as compared with prewar.

The European nitrogen deficit is caused chiefly by the post-war reduction in German production, down from a three-year average for 1936-39 of 677,000 metric tons to an estimated production for 1946-47 of 318,000 metric tons. The only nitrogen-exporting countries in continental Europe today are Norway and Belgium. All the others are importing countries with the larger requirements for France, the Netherlands, Denmark, Poland, Italy, Sweden, and Spain. Egypt and India as well as China and Formosa have large import requirements.

To sum up the nitrogen position, the evidence strongly indicates that while it is far from pleasant many countries will have to produce their crops in 1947 with 35 to 60% of their necessary nitrogen requirements. The significant point is this: the prospective total tonnage of nitrogen available for the world crops in 1947 is insufficient to produce maximum yields. It is inevitable that some countries will produce poorer crops because there is not enough nitrogen.

Phosphates

THE world supply of phosphate rock is more nearly up to world demand than is the supply of soluble phosphates. The shortage of soluble phosphates is more severe because the facilities for processing the available rock are not sufficient to meet the demand. Therefore this discussion notes mainly the soluble phosphates.

The world shortage is estimated at approximately 1,100,000 metric tons P_2O_5. This shortage is largely in continental Europe where war damage has interrupted processing facilities and transportation. Europe has always been dependent upon French North Africa for phosphate rock and this supply now nearly meets requirements. The bottlenecks in the production of soluble phosphates in Europe are inland shipping, facilities to produce the phosphates, and lack of sufficient coal. Sulphuric acid manufacture depending on pyrites and sulfur is also a problem.

The supply of soluble phosphates in North America is relatively adequate. The production of ammonium phosphates in Canada is being maintained at war levels.

In addition there are approximately 500,000 tons of ground phosphate rock to be applied directly to the soil in Europe and North America this year. Basic slag, once of real significance in European agriculture, is currently of much less importance, limited to production in England, Belgium, and Germany. Prewar European production was slightly more than 5 million tons of basic slag while now it will be only about 25% of this amount. Prior to the war, basic slag was considered the cheapest source of phosphorus for the central European countries and you can realize the postion they are in now. Germany especially in prewar had processing facilities for only about half a million tons of phosphate rock because in addition they used over 2½ million tons of slag. On the other hand, Belgium and the Netherlands had superphosphate facilities for exporting this material which are now a lifesaver for that part of Europe.

In the Pacific currently the chief enterprise is the effective rehabilitation of the production of phosphate rock on Ocean, Nauru, and other islands.

Potash

From requirements and supply estimates the world deficit of actual potash is approximately 388,000 metric tons K_2O, which is relatively less than the world deficits of nitrogen and soluble phosphates. Potash production is confined principally to the United States, France, the USSR, Spain, Palestine, and Germany. Production in France has steadily increased and their export program has been resumed. Under present plans essentially the United States supplies the countries of the Western Hemisphere, and the European producers and Palestine supply the Eastern Hemisphere.

The increase in world potash supply over prewar 1936-39 average is about 258,000 metric tons K_2O. It is contemplated that 510,000 tons K_2O will be exported from Germany to about 17 different countries. The success of the world potash distribution program depends a great deal on German potash moving to these countries.

The area under German control during the war did not suffer so greatly from lack of potash, as the mines under their control were in full operation and heavy applications were made in partial effort to offset the shortage of other fertilizers. All European countries used large dressings of potash during prewar years and the demand is still for more potash. In Asia and the Far East the consumption of potash has always been much less, with Japan as the major consumer of about 100,000 metric tons K_2O.

The United States production and consumption have greatly increased. The world supply of potash is approaching the point where the supply is nearly sufficient to meet the world demand provided that German production is maintained and exports from Germany become available to the European countries as planned.

In conclusion, there are four main points to emphasize:

1. **Because the world-wide demand for fertilizers exceeds the supply, every country that uses fertilizers is experiencing a shortage for 1946-47.**
2. **Due, however, to the cooperation of Governments and industries throughout the world, no country that has submitted its requirements is going without fertilizer.**
3. **By far the most severe shortage is nitrogen estimated as equivalent to 4,200,000 metric tons sulfate of ammonia. The world shortages of soluble phosphates and potash are less severe.**
4. **Four years of world cooperation has demonstrated to a very large degree what can be done by the people of the world to provide the equitable distribution of fertilizers for food production. ★★**

USE OF NEW TOXIC AGENTS IN Rodent Control

Justus C. Ward*
Pharmacologist, Wildlife Research Laboratory, U. S. Fish & Wildlife Service

RATS have been recognized as disease carriers since the dawn of history, and the primary role they play in the spread of bubonic plague, typhus fever, and many less important illnesses is well known. Public health officials have emphasized the importance of rat control for many years. It has been recognized that construction of ratproof buildings and the rigid enforcement of adequate sanitation regulations are fundamentals, which must be observed in order to combat rodent pests effectively. As a supplement to these procedures, however, the reduction of excess rat populations is essential. It is in this phase of rodent control that most spectacular advances have been made during the past few years.

The importance of reductional control was stressed by medical officers of the Armed Forces early in the war, when it became obvious that troops would invade portions of the world where rodent-borne diseases were known to exist. Research work to discover and test new poisons was intensified when early military action by the enemy cut off supplies of red squill, thallium and strychnine. "ANTU" and "Compound 1080" were two of the most important discoveries. "ANTU" or "Chemical 109" were the code designations of Alphanaphylthiourea, which was the first of the newer agents to be found. "ANTU" was one of those fortuitous scientific "accidents" caused by the astuteness of a competent observer whose vision enabled him to recognize the value of a chance observation. At the beginning of the "ANTU" story, Dr. Curt P. Richter of Johns Hopkins University was studying taste psychology in rats, and he noticed that when he used DTC, phenylthiocarbamide, his experimental rats usually died. As PTC had been used safely for several years in studying taste reactions in humans, Dr. Richter was impressed by its apparent toxicity to rats. Feeding trials showed that phenylthiocarbamide was refused by rats, so it became necessaary to find a chemical relative which would still be toxic, but would be more palatable. When the potential value of the thiourea compounds was explained to the Committee on Medical Research of the Office of Scientific Research and Development, it was decided that funds should be provided to follow through on the idea. Cooperation was set up between Dr. Richter and the research specialists of E. I. du Pont de Nemours and Company. A large number of substituted thioureas was synthesized, until alphanapthylthiocarbamide—or alphanapthylthiourea, as it is called, more commonly—was produced. This substance was found to have the same toxicity to rats as phenylthiocarbamide, and to be much more palatable.

Extensive field trials then were needed to test the suitability of "ANTU" for the control of various rodent pests. Arrangements were made with Baltimore health officials, and an extensive rat reductional program was instituted in the city. Simultaneously, the assistance of the Fish and Wildlife Service was requested, and a supply of the new poison was forwarded to Denver. Samples were distributed to workers in various parts of the country. Early reports showed that ANTU was entirely ineffective against California Ground Squirrels, and was about thirty times more toxic to Norway rats than it was to black or Alexandrine rats. These observations led to studies which proved that ANTU is highly specific, since it affects Norway rats more readily than it does any other species of animal. Unfortunately, it will kill dogs and is toxic in varying degrees to most carnivorous species, while being less dangerous to the herbivores ones. It is more effective against adult than young Norway rats. It causes development of tolerance, since rats which have survived sublethal doses of ANTU are able to withstand subsequent amounts which are many times the acute lethal quantities. In common with many other poisons, it has the characteristic of "educating" rats which have survived small doses, against eating baits containing ANTU again.

When all of these characteristics are given due consideration, the final conclusion is reached that ANTU has several idiosyncrasies which must be understood before the substance can be used to best advantage, but that it has promise of becoming a very useful material. ANTU is a light grey insoluble powder. It will kill adult

*Article appears also in November "American Journal of Public Health."

Norway rats at 6-8 mg/kg., and accordingly may be used effectively at 1% concentration in bait. ANTU may be employed either mixed with ground food; dusted over cut sections of fruits, vegetables, or meats; or, mixed with talc and blown into rat burrows or along rat runways. The poison is new, and there are many problems with regard to its adaptability, and to its methods of use, which remain unsolved. Dr. Richter and many of his cooperators are still studying them, however, so it is to be expected that many of these questions will be answered in the near future, and that the true value of ANTU will be demonstrated.

"Compound 1080"

DISCOVERY of Compound 1080 is an illustration of the advantages of wartime cooperation. Prior to the war, strychnine, thallium, red squill, zinc phosphide, arsenic compounds, barium carbonate and cyanides were readily available, so the search for new agents was of scientific rather than of practical importance. War changed all that, and when shortages of the more effective rodenticides appeared to be imminent, the Wildlife Research Laboratory undertook a strenuous search for substitute poisons. The importance of this project was emphasized as invasion forces encountered rat-borne tsutsugamushi disease, and the Office of Scientific Research and Development provided sufficient funds to accelerate this work. Close cooperation was set up with research units of chemical industry, certain army laboratories, and various Committees of the OSRD. Several hundred compounds, known to possess toxicity in themselves, or to contain molecular configurations suspected of being toxic, were obtained for tests. Finally, Division 9, National Defense Research Committee, OSRD, sent 10 chemicals to the Fish and Wildlife Service laboratory at the Patuxent Refuge, where preliminary toxicities were being run. One of these ten was given the invoice number "1080."

Stomach tube tests showed that "1080" and one or two others of this batch of chemicals were highly toxic, so they were forwarded to Denver for further examination. "Compound 1080" was found to be the only one of the ten meeting all of the requirements, and, the first of the several hundred chemicals tested, to show evidence of becoming a satisfactory poison.

As the first reports reached the OSRD, it became apparent that "1080" was the new poison which had been sought by Service Forces and Public Health agencies for fighting rodent-borne diseases. The need for haste in testing "1080" was obvious, and the OSRD set up a Rodent Control Subcommittee to expedite that program. Through the whole-hearted cooperation of the U.S. Fish and Wildlife Service, the U. S. Public Health Service, the Surgeon General's Office of the Army, the Bureau of Medicine and Surgery of the Navy, the U. S. A. Typhus Commission, the Chemical Warfare Service, the University of Chicago Toxicity Laboratory, the British Commonwealth Scientific Office, the Texas State Department of Health, the Pan-American Sanitary Bureau, any many others, it was possible to get worldwide studies with "1080" underway. The results of all of this work have been most revealing. As a poison for the control of certain pests, "Compound 1080" has no equal. It is highly effective against all species of rats, it is satisfactory for the control of mice, it gives phenomenal control of prairie dogs, California and Columbian ground squirrels, and gives promise of being useful on other species on which it has not been tested. In short, "1080" is too dangerous for general distribution.

Whereas "ANTU" is reasonably safe for the inexperienced layman to use, "1080" has been proven to be a tool for only the most expert and careful specialist. To the pharmacologist familiar with strong poisons, the toxicity of "1080" is almost unbelievable. The table on the next page illustrates that point.

The comparative toxicities of "1080" to dogs, cats and rats, foreshadows one of the most serious disadvantages of this poison. Because of their greater sensitivity, dogs and cats are killed by eating sick or dead rodents killed by "1080." This means that pets must be removed from areas where this poison is exposed, and must

Typical Toxicities of Sodium Fluoroacetate (1080).

Animal	Route of Administration	Approximate LD 50%
Dog	IV	0.1 – 0.2 mg/kg
Coyote	IP Less than	0.2 mg/kg
Rabbit	IV	0.3 "
Pig	IP	0.3 "
Cat	IP	0.3 "
Calif. ground squirrel	Fed	0.3 "
Black-tailed prairie dog	Fed	0.3 "
Guinea pig	Fed	0.3 – 0.4 mg/kg
Field mouse	Fed Less than	0.5 mg/kg
Bobcat	IP Less than	0.67 "
Goat	IM	0.7 "
Rat (black species)	ST	1.0 "
Rat (Norway)	ST	3.0 – 4.0 mg/kg
Monkey (Rhesus)	IV	5.0 – 7.5 "
Monkey (Spider)	IV	10.0 –12.0 "
Chicken (Rhode Island Red)	Fed	6.0 – 7.0 "
Frog	SC	1000.0 –2000.0 "
Horse (British data)	Not given	1.0 mg/kg

Note: Experiments at Edgewood Arsenal have indicated that the route of administration has a minor effect on the toxicity of "1080." Consequently, it was considered permissible to compare the results obtained by intravenous injection (IV); stomach tube (ST); intraperitoneal injection (IP); subcutaneous injection (SC); and intramuscular injection (IM); with those determined by feeding.

be kept away until all bait and all carcasses have been picked up.

In fact, there is only one advantage appearing on the list of toxicities given above, and that is that primates are less susceptible to "1080" than are most of the lower animals. That makes it possible for us to assume that there is a relative degree of resistance in humans.

The high susceptibility of rodents makes it possible for a very small amount of the poison to be used in bait, and as a consequence, normal baits containing "1080" are not extraordinarily dangerous to humans. In the table given below, the strongest concentration of "1080" recommended in any standard formula is used.

This is the mixture of ½ oz. of "1080" in 1 gallon of water. Rat food baits use 1-gm. of "1080" per pound (1-oz./28 lbs.) and field rodent formulas use only 1 or 2 ounces per 100 pounds of grain. These baits would be less dangerous to man because of the weaker concentration of poison than would be true of the water mix. It is of interest to compare the relative danger from baits containing several of the common poisons.

In interpreting this table, one important factor must be considered. There is no known antidote for this new poison, and its rapid absorption makes the use of first aid measures effective for only a short time after the poison is swallowed. Much work has been done to find an effective treatment for "1080," and the following suggestions are offered by the Chemical Warfare Service.

Antidote for 1080 Poison

TREATMENT is limited to the use of emetics, and the poison must be eliminated within a few minutes if the absorption of dangerous quantities is to be prevented. Make the patient vomit at once by tickling the throat with the finger, or give ½ teaspoonful of powdered mustard in a cup of warm water. Give a dose of Epsom Salts as a purge. Call a physician at once and give him the following information:

For the Physician: Compound "1080" affects the myocardium and the central nervous system. In primates the effect on the heart is the primary cause of death. Pulsus alternans appears first, followed by premature systoles and ventricular fibrillation. The central nervous system reaction is shown by epileptiform convulsions. Following treatment to remove the poison, place the patient at complete rest. Control the CNS excitement by careful use of barbiturates having a moderate duration of action, such as sodium amytal. Little else can be done to arrest the cardiac symptoms.

This summary would not be incomplete without reference to two chemicals discovered in Germany during the war. The first of these was p - Dimethylaminobenzene diazosulfonic acid, sodium salt. This substance was moderately toxic, and was reported to be rather effective in the control of rats in Germany. The other was 2-Chloro-4-dimethylamino-6-methylpyrimidine, called "Castrix"—obviously for convenience. This chemical was a great deal more toxic, and was said to be an excellent substitute for thallium. Adequate supplies of these materials have not been made available as yet to workers in the United States, but arrangements have been completed to obtain reasonable lots of both poisons for study. Enough work has been done, however, to justify the belief that neither will be su-

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Toxicities to Man of Rodent Baits Prepared with Common Poisons

Poison	Accepted Lethal dose to man. mg/kg	Concentration Used in Baits	Ounces of *Bait* Containing a Lethal Dose for a 150-lb. man.
As_2O_3	1.5 – 15.0	3% (1 part in 33 parts)	0.12 – 1.22 ounces
Strychnine	1.0	0.3% (1 " " 320 ")	0.8 ounce
1080	5.0	0.4% (1 " " 256 ")	3.15 "
Tl_2SO_4	20.0	1.5% (1 " " 65 ")	3.2 "
Zn_3P_2	40.0	2.0% (1 " " 50 ")	4.9 "
$BaCO_3$	800.0	20.0% (1 " " 5 ")	9.9 "
ANTU	Unknown	5.0% (1 " " 20 ")	Probably very large

The Story of PYRETHRUM

By Pat Jarrett
Greene Trading Co., New York

African Kenya colony still foremost producer of pyrethrum flowers. Annual exports to U. S. amount to 5,000 tons. 80% of world pyrethrum supply used in U. S. for sprays and dusts

MANY of the more commonly used and valuable insecticides possess the serious disadvantage that, though very effective for their particular purposes, they are toxic to man and animals. Therefore, an important aspect of insecticide investigation has been the search for non-toxic products of equal value, which has led to the development and use of insecticide materials derived from plant sources.

One of the most important of this type of insecticide is pyrethrum, in the production of which the Province of Kenya, British East Africa, occupies a leading place in the world.

The insecticidal value of the dried flowers of the pyrethrum plant has been known for a very long time. The plant is said to have been introduced into Europe soon after the year 1800 by an Armenian merchant whose son subsequently began the manufacture of pyrethrum powder on a commercial scale in 1828.

Although Kenya has made its name well-known as a paradise for big game hunters, the Province has a role of greater importance than that of a playground. Throughout the length and breadth of the highlands are scattered the farms of the white settlers who face the usual agricultural conditions of tropical latitudes and alpine altitudes. This pioneering community, barely a hundred years old, is fresh with all the enthusiasm and enterprise of youth. Here nothing in the way of agricultural adventure and experiment is left untried, and one of the most successful crops is the cultivation of pyrethrum.

The history of pyrethrum growing in Kenya began with the visit of a Kenya settler to the Imperial Institute in London where, following discussions as to the possibility of introducing new crops to the Kenya Highlands, it was decided to send out a trial consignment of pyrethrum seed. From the very start pyrethrum grew well, but it was not until coffee farmers discovered that pyrethrum emulsion proved a most excellent antidote against the capsid insect that public attention in Kenya became focused on the crop. Samples sent to the United States assayed 1.54% combined pyrethrin content, which indicated that pyrethrum flowers grown in Kenya contained a higher percentage of pyrethrins, the toxic principle, than those grown in any other part of the world.

This was an encouraging start for the new venture, and immediately inspired the ambitious idea of making Kenya the main source of supply of pyrethrum for the whole world.

World War II was probably the greatest contributing factor in increasing production and in setting a very high priority on pyrethrum for the health of Allied Armies, proper food storage and intensified agricultural production. Japan was by far the greatest producer of pyrethrum before the war but supplies were completely cut off after Pearl Harbor. Since supplies from Yugoslavia, another smaller source, had been cut earlier, Kenya then became and still remains the only important world supplier of pyrethrum.

For many years, pyrethrum supply has been of growing interest to the United States. Before the war, over 80 percent of the world's pyrethrum supplies were used in the U. S. as a base for insecticide sprays as well as agricultural sprays and dusts for use in arable and stock farming. With the increased development and use of aerosols, and the British Government's guarantee of purchase through 1947, pyrethrum production in Kenya has greatly increased. Land under cultivation now totals some 60,000 acres, and annual exports to the United States

alone have now reached approximately 5,000 tons valued at approximately $3,000,000.

Co-operation Helpful

DEVELOPMENT of the pyrethrum industry in Kenya is a very fine example of close collaboration between the farming community and the officers of the Kenya Department of Agriculture. Through the patient research and combined efforts of these individuals it was well established by 1932 that pyrethrum would flower under the conditions of the Kenya highlands from altitudes of 5,500 feet upwards.

The two types of planting materials used are either seedlings or splits—root divisions from existing plants. The seed, kept fresh as possible since it tends to lose viability on storage, is thinly sown in a nursery bed provided with light top shade. Seeds are generally planted in December and January so that they may be transplanted into the fields after the heavy rains which generally end in April or May. If planted too thickly the seedlings suffer from damping-off or have to be pricked out to a wider safe spacing—an operation which increases the cost of planting considerably.

Plants descended directly by splits from the original parent plants which furnished the first despatch of seed can be seen today in the experimental section of the Government Agricultural Nurseries at Harpenden, England, and their attenuated appearance, caused by the less favorable climate of England, is in strange contrast to the lusty prolific plants so common in Kenya.

Pyrethrum plants do not like virgin soil. They thrive best on land which has previously borne a crop of wheat or other cereal. Today pyrethrum is grown by nearly 1000 farmers in East Africa. Because of the high labor costs involved in the almost continuous weeding for successful cultivation, pyrethrum is not what might be termed a popular crop among the farmers. It is a garden flower and must be treated as such to obtain the best results. This calls for constant care and attention, the most important of which is a meticulous process of weeding, the operation of which must not disturb the root system. Pruning, too, must be carried out annually and the success of this can depend largely on local knowledge of rainfall conditions. Too early pruning may give a false flush of insignificant flowers, while on the other hand, pruning too late may affect the total yield adversely. When it is remembered that one farmer may cultivate anything from 50 to 150 acres, and that one acre may contain 15,000 plants, the size of the labor force necessary to handle the crop can easily be estimated.

Flowers Most of Year

FLOWERING in Kenya is practically continuous for ten months of the year—April to the end of January—when a plant may carry every stage of development from tiny buds to over-mature flowers. Great care is exercised over the picking operations to ensure that only flowers at the correct stage of maturity are harvested—when 3 to 4 rows of disk florets are fully open. Picking of immature flowers and buds, which results in the lowering of the pyrethrin content, is avoided. Under such conditions it is not possible to harvest the crop with sickles and strip the flowers by machine. The flowers are plucked individually by hand in the fields.

Native labor is employed by the farmer and payment for picking is usually made on the basis of weight. The average adult male laborer can pick between 50-70 lbs. of wet flowers in a day. The best pickers however are native women and children—the men do not relish the stooping entailed.

Planting pyrethrum in Kenya. Seedlings are generally set out following heavy rains which end in April or May. Plants thrive best on soil previously used in growing wheat or other cereal. Virgin soil is usually avoided.

When flowers bloom . . . usually over a ten-month period from April through January . . . great care is taken to pick at correct stage of maturity, when pyrethrin count is greatest. Flowers are picked individually, by hand.

Money earned by the native women in picking pyrethrum flowers does not go into the family exchequer but is jealously guarded as pin money. Kenya native women and girls are fond of ornaments, anklets, bracelets, nose-clips, gigantic ear rings, and peculiar brass rings clamped permanently above the elbow and above the calf of the leg. For the purchase of these ornaments, the money received from picking pyrethrum flowers is very welcome.

Picking is performed at intervals of from two to three weeks throughout the picking season. To avoid overheating and sweating in the tropical sun, flowers are thrown into open woven baskets, carried on the back, as they are picked. As each basket is filled it is emptied into a larger receptacle and the picker credited by the native overseer. At least three times a day the flowers are transported to a drier so that the danger of overheating and fermentation is reduced to a minimum. The yield of a crop will vary according to altitude. At the lower limit of economic production, about 5,500 ft.-6,000 ft., the yield is about 250 pounds per acre, although local conditions at this altitude may send the yield up to 300 to 400 pounds. At the higher elevations, 8,500 ft.-9,500 ft., yields of 500 to 600 pounds per acre are usual.

In the early days of the industry in Kenya the flowers were dried in the sun, and partial sun-drying is still done on many estates. The humidity during the flowering season is fairly high, however, making complete drying in the open a delicate matter. This, combined with the fact that large quantities of flowers are often handled on one estate, has made the practice of artificial drying almost universal in Kenya.

As soon as a batch of flowers is dry it is packed into burlap sacks each holding 60 lbs. The flowers are then transported to the nearest railway station to be forwarded to the central grading and baling station at Nakura where they are carefully inspected and graded. The centre at Nakura is operated for the Pyrethrum Board of Kenya, by the Kenya Farmers' Association, a progressive co-operative formed in 1923. The Pyrethrum Board of Kenya is a statutory body which controls the industry. All pyrethrum growers, both white settler and African native, are required to register with this Board. The setting up of this sole buying and selling agency has had a very beneficial effect upon the development of the pyrethrum industry. For instance, the grading rules of the Kenya Farmers' Association, as laid down by the Board, are high, and their rigorous enforcement has helped to improve the quality and appearance of the Kenya insecticide product. Further, under the "Kenya Pyrethrum Ordinance," enacted in 1938, all pyrethrum produced in Kenya has to be sold to a single buying and selling agent, namely the Kenya Farmers' Association. The farmer does not have to export his pyrethrum crop to an agent overseas for sale and wait for the proceeds; he is credited on delivery at the Nakura centre and receives payment each month.

Regular analysis of the flowers upon arrival at Nakura encourages the farmers to produce flowers containing the maximum pyrethrin content. After grading, the flowers are mixed and sent to hydraulic presses where they are made into bales of 400 pounds each. A bale measures 24 in. x 22 in. x 37 in., and is wrapped with scrim and sacking and bound with steel bands.

Pyrethrum for export is sold

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Artificial drying of picked flowers is almost universal in Kenya, because high humidity out-of-doors makes complete drying a delicate matter. Large drying ovens like the one below take care of most of drying needs.

Rigorous inspection of flowers before baling for export is made by the Pyrethrum Board of Kenya. Grading rules of Farmers' Association are high, and have helped improve quality and appearance of produce from Kenya.

"Borrowed" Fertilizer Not to be returned!

National Association hears news at Atlanta Convention. Government surplus is to be exported, rather than distributed to American farms.

THE disturbing news that the government now plans to export all the available surplus of ammonium nitrate, rather than to return to domestic consumers quantities "borrowed" earlier this year, was given to members of the National Fertilizer Association at their recent meeting in Atlanta. L. G. Porter, chief of the Fertilizer Branch, Production and Marketing Administration, U.S. D.A., who addressed the group on the domestic fertilizer supply situation, indicated that ammonium nitrate equalling the quantity borrowed will be available from new government production, but it is planned to export all government plant surplus rather than to return the quantity loaned by the fertilizer industry.

Mr. Porter's talk was one of the two reviews of the fertilizer outlook which highlighted the meeting. The other address was a discussion of world supplies by Dr. O. E. Overseth, Secretary, Committee on Fertilizers, International Emergency Food Council of the United Nations, which completed a round-the-world review of the fertilizer picture. Both addresses appear in full elsewhere in this issue.

The two-day business session, the 20th annual southern convention of the National Fertilizer Association, was held at the Atlanta Biltmore Hotel, Atlanta, November 12 and 13, being preceded on the 11th by a meeting of the board of directors of the association. Morning business sessions were held on the 12th and 13th with Weller Noble, of Pacific Guano Company, Berkeley, chairman of the board, and R. L. King, Georgia Fertilizer Company, vice-chairman, sharing the duties of presiding officer.

In his report to the membership, Mr. Noble announced the names of chairmen of various association committees as follows: Plant Food Research Committee, H. B. Siems, chairman; Public Relations Committee, C. T. Prindeville, chairman; Budget Committee, R. L. King, chairman; and Membership Committee, Leon Davis, chairman. The names of other members of these committees will be announced shortly. A new member of the N.F.A. board, elected at the Atlanta meeting, is M. G. Field of Meridian Fertilizer Factory, Hattiesburg, Mississippi. The board selected the Essex and Sussex Hotel, Spring Lake, N. J. as the place for the annual meeting to be held in June, 1947.

A feature of the first morning session, November 12, was a panel discussion on the legislative outlook, participated in by Maurice H. Lockwood, N.F.A. president, Bert C. Goss, J. H. Epting, and R. L. King, with C. T. Prindeville presiding. The threat of government competition with the fertilizer industry was the general theme of the discussion, and special attention was accorded to the proposal advanced in Congress last Spring, and finally defeated, that a government fertilizer plant be set up in Mobile in connection with T.V.A. operations there. Members of the N.F.A. were advised that of 126 representatives in the House who voted for this proposed plant, 33 had been defeated in the recent election and would not be members of the 71st Congress. Those most active in favor of the project, however were re-elected.

With an apparent mandate from the electorate to swing away from collectivism and government

National Fertilizer Association panel on Legislative Outlook meets at Atlanta Convention. Left to right: Weller Noble, chairman NFA Board, who presided over all the sessions; R. L. King, Valdosta, Ga.; J. H. Epting, Leesville, S. C.; C. T. Prindleville, who presided over Panel; Bert C. Goss, Hill and Knowlton, public relations counsel, Washington, D. C.; and M. H. Lockwood, NFA President.

ownership back toward competitive private enterprise, it seems probable that no outright proposal of government ownership and operation of fertilizer plants may be offered in new legislation at the coming session of Congress. The industry was advised, however, that the national fertilizer program of the farm groups will be persevered with, and there will probably be a bill to authorize extensive government-financed research and experimental work on fertilizers. In such a program, operation of government-owned fertilizer plants might be slipped in under the guise of putting research ideas to practical test. Members of the industry were urged to make their feelings on the subject of government competition clear to their representatives, and to enlist the support of their dealers and distributors in repelling this threat to private ownership. They were also urged to make every effort to boost production of fertilizers, so that no excuse could be offered by the proponents of government fertilizer manufacture on this score.

Dean M. J. Funchess, director of the Alabama Agricultural Experiment Station at Auburn, Alabama, spoke on post-war agricultural problems facing the South. There are many millions of acres of unproductive land in the South, he said, which must be converted to production of new crops. The South, he warned, cannot prosper on cotton alone. It must have new crops, and the contribution of the fertilizer industry will be to develop new fertilizers to make these new crops possible.

During the convention Maurice H. Lockwood, N.F.A. president, broadcast over WSB, Atlanta radio station, discussing the important role of fertilizer in American farm economy. Use of fertilizer, he stated, boosts American farm output 20%, an increase in productive capacity which it would take an additonal fifty million acres of farm land to equal. When compared to other areas, he said, the South's use of fertilizer has not increased proportionately. In Iowa, for instance, use of fertilizer has risen 800% above pre-war levels.

In spite of war time obstacles, production of fertilizer has doubled as compared with pre-war levels, reaching a total output of over fourteen million tons in 1946. Prices have been held down and are not expected to skyrocket despite OPA's end. The levels of early 1946 were only 22% above the 1910-1914 base period, as compared with a rise of 88% in farmers' expenditures for all commodities over the same period. Quality of fertilizers is constantly rising, Mr. Lockwood said. About forty years ago the industry developed high analysis phosphates, and since that time manufacturing processes have been continuously improved, with a steady increase in the phosphoric acid content of such fertilizers. The manufacture of ordinary superphosphate has also improved.

For the 1947 planting season, Mr. Lockwood predicted that the farmer's chances of securing adequate fertilizer supplies would be considerably better than in 1946.

Discussing the acute shortage of freight cars at the final convention session, C. R. Megee of the Association of American Railroads indicated that the car supply problem is more serious now than at any time during the war, the biggest problem being the shortage of box cars. There was of course very little building during the war, and with equipment operating at a peak level, obsolescence was rapid. New cars are now being built at the rate of about 2,000 a month, but retirements are still in excess of new production, and will probably continue so until sufficient steel and labor can be turned into car production.★★

Use of Fixed Coppers on Vegetables

THE copper-containing fungicides find their greatest use on vegetables, whereas sulfur compounds are more commonly used on fruits. Bordeaux mixture, which is the best known of the copper fungicides, had the vegetable field almost to itself from its introduction over 50 years ago until about 1940. Bordeaux has been, and probably still is, the nearest approach to a universal fungicide for use on vegetables. This, together with high tenacity and low cost, makes it a formidable opponent in any move toward replacement, especially on such crops as potatoes and celery that are highly tolerant of its phytotoxic effects. This tendency of Bordeaux mixture to cause injury to various host plants like tomato and some of the cucurbits was one of the reasons why the less injurious fixed coppers after gradual progress, have now replaced Bordeaux in many instances.

Bordeaux injury is manifested in various ways, but chiefly through a slowing down of growth, together with the resulting malformations. The primary cause of this action is an increase in the rate of water loss from the leaves and growing points of treated plants. This desiccating effect is most active just as the spray material dries and for a few hours thereafter. Immediate injury is largely confined to the cuticle and epidermis of the host tissue and this in turn allows the underlying cells to lose water more rapidly than usual. The reaction is most noticeable when the treated plant is suffering from a lack of water, as during drouth periods or just after transplanting.

One of the most striking examples of Bordeaux injury ever encountered by the author was observed during the extremely dry summer of 1930 when ginseng plants growing in a woodlot were completely defoliated in plots sprayed with Bordeaux mixture, whereas adjacent plots treated with other materials were unaffected. Tomato transplants may be killed by the presence of Bordeaux on their leaves, even though it may have been applied as many as 5 days previous to their removal from the plant bed. In other instances the normal growth rate of cucumber vines over a given period has been halved by the application of Bordeaux. These and many other instances have served to emphasize the desirability of obtaining other fungicides (copper-containing or otherwise) for use on Bordeaux-sensitive host plants. The fixed, or low-solubility coppers which began to appear in test plots in the early thirties, were one outgrowth of the search for substitute materials.

An excess of hydrated lime is commonly used in the preparation of Bordeaux mixture to insure the complete transformation of the copper sulfate to copper hydroxides. This excess of lime with its highly alkaline reaction is believed to be chiefly responsible for the phytotoxic effect of Bordeaux. These copper hydroxides, which are slowly soluble with lime under the influence of environmental factors, are in effect fixed coppers. Copper hydroxide together with other similar copper compounds can be prepared in the chemical laboratory, pilot plant, or factory in such a way that no lime is present in the finished product, and need not be added later. It does not follow, however, that all fixed coppers prepared and used in this manner are non-toxic to the treated plant, or that they possess the fungicidal efficiency of Bordeaux mixture.

Fixed Copper Groups

THE fixed coppers, as they have been prepared for use as fungicides, may be classified into four general groups. These are the oxychlorides, the basic sulphates, the oxides, and a miscellaneous group that includes a combination of an oxychloride and a sulfate (COC-S), as well as various hydroxides, arsenates, and others like an oxalate, silicate, acetate, phosphate, stearate, etc. The best known oxychlorides are Copper A and Cupro K. Among the basic sulfates are such trade names as "Tribasic," "Basicop," and "Spraycop"; and "Cupro-

Bordeaux mixture still most widely used; but phytotoxic properties on certain plants encourage introduction of other copper fungicides. Adhesion of coppers a problem.

By J. D. Wilson
Ohio Agricultural Experiment Station, Wooster, Ohio

cide" is the most widely used oxide. Other names include "Coposil," "Copper Hydro 40," "Copper Zeolite," "Basic Copper Arsenate," "Brown Cupric Hydrate," and "Bordow."

In general, the fixed coppers are somewhat less effective in the control of vegetable diseases than is Bordeaux mixture, but the final yields of various crops are frequently as great (or greater) from experimental plots treated with the fixed coppers as from those sprayed with Bordeaux. In other words, the benefits of better disease control from Bordeaux mixture are often more than offset by the depressing effects of the plant injury it causes.

The fixed coppers vary somewhat in their adherence to plant foliage. As a group they are less adhesive than Bordeaux and therein lies one of the reasons for their lesser efficiency in disease control. If the initial deposits of copper are comparable after spraying with the average fixed copper and Bordeaux mixture, the amount of copper per unit of leaf area after a hard rain is seldom more than half as great for the former as the latter.

Particle size plays a disputed but nevertheless important role in regulating the fungicidal efficiency of the fixed coppers, chiefly because fine particles give better distribution patterns than coarser ones per unit of weight of the active ingredient. Fine particles adhere somewhat better than larger ones. As a result, the fine particles of yellow "Cuprocide" usually give better disease control than those of the coarser red "Cuprocide." The "Tribasic" of 5 years ago has been improved as a fungicide by producing it in the form of finer particles.

The use of fixed coppers as Bordeaux substitutes introduced several new problems dealing with such questions as concentration of the active ingredient, application interval, the need for wetting and adhesive agents, and diluents if dusts were to be used. In most instances it has been found that the same amount of copper (stated as the metallic equivalent) should be applied in the form of a fixed copper as is used in Bordeaux mixture. Thus, 4 pounds of a material like COC-S (52% metallic) should be added to 100 gallons of water to spray a crop such as celery for which the Bordeaux formula is an 8-8-100. The same time interval between applications is commonly recommended for both the fixed coppers and Bordeaux mixture and varies with the crop from 6 days on celery to as long as 12 days on carrots.

Wetting and adhesive agents are somewhat more important for use with the fixed coppers than with Bordeaux, which naturally adheres well and also wets the foliage of many vegetables better than fixed copper formulas. However, the influence of spreaders and stickers on adhesion and disease control often appears to involve many misconceptions and inconsistencies. For instance, many of the materials commonly recommended for use with a compound like lead arsenate have proved to be of little use as stickers and load builders with the fixed coppers on vegetable foliage. Many wetting agents actually cause a smaller initial load of copper and later decrease adhesion. Many so-called adhesives fail to improve adhesion during weathering, or if they do they are responsible for various types of injury. Bentonite is an excellent adhesive but this material plus many of the fixed coppers is nearly as phytotoxic as Bordeaux. Most resinates cause similar responses and oils often decrease control efficiency, and may be injurious unless very carefully used.

Advocates of fixed coppers as Bordeaux substitutes for the control of vegetable diseases often mention the fact that they may be applied as dusts in the absence of dew and still give fair results, whereas the presence of moisture on the foliage at the time copper-lime dust is applied is quite essential. This is largely true, but even the fixed coppers are most effective when applied to moist foliage, as would be expected, since initial load and final adhesion are increased.

Common practice involves the use of diluents or carriers with the

fixed coppers when they are to be applied as dusts. There are several reasons for this but the most logical one is probably the fact that dusters, large and small, are not now properly designed to distribute evenly amounts as low as 4 to 6 pounds of a fixed copper compound over the foliage of an acre of vegetables. Recent tests with a new type of duster indicate that dusts of much higher copper content than those containing the conventional 7 percent of copper as metallic can now be used. Be that as it may, it is likely that diluents will continue to be used in considerable quantities.

A complete discussion of the relative merits of dust diluents would require more space than is available here. In brief, they should be chemically inactive (alone or in combination with the active ingredient), of medium weight-volume relationship (30 to 45 pounds per cubic foot), not too abrasive to the application equipment, of good flowability, and lastly they should be finely enough divided to pass from 90 to 95 percent through a 325-mesh (44 micron openings) screen. Care should of course be taken to have the active and inert ingredients thoroughly mixed.

There is a common tendency among growers and even those conducting experimental tests to skimp or economize on the amount of dust used. If a 4-100 spray is applied at the rate of 150 gallons per acre, a 7 percent dust should be applied at the rate of 43 pounds to furnish the same amount of active ingredient. Recommendations of 30 to 35 pounds of dust per acre are common, and growers are sometimes found trying to get by with 25 to 30. Since dusting is usually less effective in disease control than spraying, even when comparable amounts of copper are applied, due to smaller initial deposits and poorer final adhesion, at least 45 to 50 pounds of a 7 percent dust should be used.

Pathologists have been comparing the fixed coppers with other fungicides for the control of vegetable diseases for a number of years, formerly with Bordeaux mixture and more recently with the "organics." As a result the recommendations for various diseases have become fairly well standardized in many parts of the country. The copper content of the fixed coppers varies widely, as everyone knows who has worked with them. This variation is actually from abou. 20 to 85 percent. For the sake of convenience the recommended spray formulas are usually stated as so many pounds of a material that contains 50-53 percent of copper in 100 gallons of water. The weight of others is then calculated to furnish the same metallic equivalent.

Specific Uses Listed

SPECIFIC recommendations for use of fixed coppers on various crops are somewhat as follows: Alternaria and Phytophthora blights on potatoes require a 4-100 formula at the rate of 150 to 200 gallons per acre on a 10-day schedule when used with DDT; the same diseases of tomato, as well as Septoria leaf spot, are fairly well controlled with the same recommendations, but a fixed copper may be alternated with an organic like "Zerlate" for better control of anthracnose fruit rot; celery blights (Cercospora and Septoria) should also respond to the 4-100 formula, but the interval should be shortened to 6 days; the formula may be reduced to a 3-100 to control the Macrosporium and Cercospora leaf blights of carrot in applications made every 10 days, and the use of a wetting agent is desirable; the cucurbits should be treated with the same 3-100 formula at intervals of 4 days on young plants and 7 to 10 days on the larger ones; finally, a 4-100 concentration is suitable for crops such as beets, peppers, eggplant, etc., if there is a specific need for the control of foliage diseases.

It is inadvisable to spray snap or lima beans with most of the fixed coppers because of injury, but a mild Bordeaux (4-4-100) is, strangely enough, much safer on this crop. A dust formula that contains 7 percent of copper (as the metallic equivalent) may be substituted for sprays on most vegetables with an application rate of 40 to 50 pounds per acre. It is best to spray carrots but dusts are usually preferable for the cucurbits, where they may be supplemented with various insecticides, of which rotenone usually gives the best results.

Trade name preferences vary from state to state and with pathologists as individuals, which is undoubtedly as it should be. In general, the basic sulfates are least phytotoxic and of only medium fungicidal efficiency. The cuprous oxides are usually somewhat more phytotoxic but also more efficient as fungicides. The oxychlorides sometime cause injury but most of them are excellent fungicides. Miscellaneous materials vary considerably in both respects.

The basic sulfates represented by "Tribasic," "Basicop" and "Spraycop" usually give the best results on carrots and cucurbits and do fairly well on tomatoes, but are somewhat less effective than various other compounds on celery and potatoes. The oxychlorides, which are well represented by "Copper A," give good results on practically all vegetables, but sometimes cause injury on potatoes and carrots. "COC-S," which is a mixture of an oxychloride and a basic sulfate of copper, is one of the least injurious of the fixed coppers and yet one of the most universally effective in disease control. The oxides, as represented by "Cuprocide," give good disease control in nearly every instance but are sometimes injurious on potatoes and the cucurbits.★★

Actual copper content of fixed coppers varies from 20 to 85 per cent . . . a fact which beclouds recommendations unless further explanations are made to user

Fumigation of Grains and other stored foods

By R. T. Cotton and H. H. Walkden
USDA, Agricultural Research Administration Bureau of Entomology and Plant Quarantine

Part I

FUMIGANTS play an important role in the preservation of stored grains and other foodstuffs from insect damage. Penetration of large bulks of foodstuffs by an insecticide to control insects working far beneath the surface, can be accomplished only in the vapor of the insecticide. Fumigants to treat any type of foodstuffs under almost any circumstances are now available, to surmount the problem of insuring an adequate concentration of the fumigant in places where the insects are, and to maintain it there for a sufficient period to kill the pest.

Factors Affecting Efficiency

There are a number of important factors that affect gas concentrations in a grain bin, warehouse, mill, box car, or other structure under fumigation. A thorough understanding of these factors is necessary, and due allowance must be made for them before successful results can be obtained.

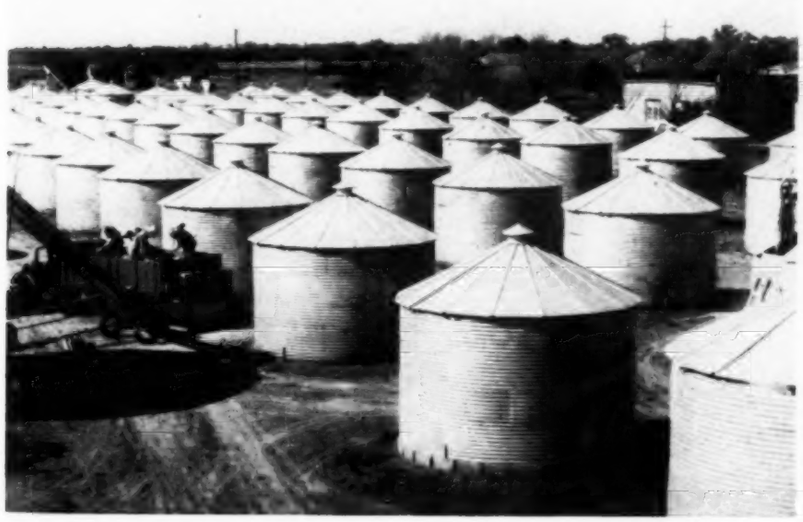
Air Leakage

The natural air movement through a building or other structure is governed largely by the type of construction, the pressure exerted by the wind, the efficiency of the sealing operations, and the wind protection from nearby structures. By wind pressure air is forced into the structure on the windward side through cracks or porous construction, and a similar quantity of air leaks out on the leeward side through similar openings. If the structure is under fumigation, a portion of the fumigant will also escape with the escaping air.

The Heating, Ventilating and Air Conditioning Guide, published by the American Society of Heating and Ventilating Engineers, includes a table on the rate of air leakage through walls of different construction at different wind velocities. The fact that the air leaks through a 13-inch brick wall at the rate of 21.2 cubic feet per square foot per hour when the wind velocity is 30 miles per hour indicates the necessity of considering the effect of wall construction and wind velocity on the dosages of fumigant to be applied.

Construction

Several years ago Cotton, Young, and Wagner (*1*) studied the effect of building construction on gas concentrations in flour mills under fumigation with hydrogen cyanide. They found that effective concentrations are difficult to maintain for more than a short period unless the mill is



Steel bins on an experimental storage site in Hutchinson, Kansas. This type of bin is considered to be excellent for the storage and fumigation of grain, allowing but small leakage.

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of very tight construction. The average gas concentration in the mill designated by these authors as No. 4, which was of modern, concrete construction, was above 5 ounces per 1000 cubic feet at the end of 2½ hours of exposure, even though the initial dosage of hydrogen cyanide was only 8.6 ounces per 1000 cubic feet. At the end of 18 hours the concentration was still approximately 2 ounces per 1000 cubic feet. Wind velocity did not exceed 6 miles per hour during the exposure period.

In mill No. 1, of stone and frame construction, with an initial dosage of 7.6 ounces of hydrogen cyanide per 1000 cubic feet, the gas concentration had fallen below 2 ounces per 1000 cubic feet at the end of 2 hours. Wind velocity ranged from 3 to 29 miles per hour. However, the mill was protected by surrounding buildings.

In mill No. 2, of frame and sheet-metal construction, the initial dosage of hydrogen cyanide was 11.25 ounces per 1000 cubic feet. With a wind velocity of 25 miles per hour, gas concentrations in the mill on the windward side never reached 2 ounces per 1000 cubic feet. Obviously warehouses or mills of concrete or of brick plastered on the inside are the most efficient for retaining fumigants. It is extremely difficult to make single-walled wooden structures or buildings of frame and sheet-metal construction tight enough for efficient fumigation. In warehouses and mills the air leakage around windows must also be considered. In a high wind the leakage around a poorly fitted window that is not weather-stripped may be as high as 249 cubic feet per foot of crack per hour. Such openings should be carefully sealed to eliminate fumigant loss.

Absorption of gas by the walls and roofs of warehouses and mills may also account for considerable loss of fumigant. If surfaces are painted, the absorptive capacity is greatly reduced.

The best types of storage bins for the fumigation of grain are of concrete or of steel welded or carefully caulked (fig. 1). If constructed of wood, they should be lined with fibre-reinforced paper or be of double-wall construction with a layer of fibre-reinforced paper between. The grain storage bin shown in figure 2 is a common type throughout the country. It is difficult to retain the fumigant in such a bin long enough for it to be effective.

Distribution of Fumigant

Uniform distribution of the fumigant in a structure is essential for best results. Mechanical means of distributing the gas can be employed in grain elevators where the grain can be moved from one bin to another. Fumigants such as calcium cyanide or chloropicrin can be fed into the grain stream at a uniform rate by means of special applicators, and certain types of fumigants can be poured into the grain stream at regular intervals by hand as the bin is being filled.

When grain cannot be turned, as in the farm bins and in some very large elevator bins, the entire dosage is sprayed uniformly over the top surface. If the grain temperature is 80° F. or above, the vapors of heavier-than-air fumigants will penetrate as much as 80 feet of grain. In small farm bins, where air leakage is considerable, it is difficult to maintain a uniform concentration of ordinary grain fumigants throughout the bin for more than a brief period. However, by using mixtures of appropriate fumigants excellent results can be obtained. When a mixture of ethylene dibromide, ethylene dichloride, and carbon tetrachloride is applied to the surface of the grain, the ethylene dibromide will be held in the top layer, the ethylene dichloride in the middle section, and the carbon tetrachloride in the lower portion of the bin. Such a fumigant mixture will give a more nearly uniform kill throughout the bin.

In the fumigation of a warehouse or a mill when it is only partially loaded, the problem of obtaining a uniform distribution of the fumigant is somewhat different. Of the fumigants in common use only hydrogen cyanide is lighter than air, its density being 0.95 relative to air. When gases that are heavier than air are released in a building, they concentrate in layers just above the floors. In studying the behavior of ethylene oxide in empty warehouses, Page and Lubatti (3) found that when it was released from cylinders on the floor the concentration at the floor remained more

than twice as high as that at the eaves throughout the fumigation, unless mechanical means were used to help distribute the gas (fig. 3). If the gas is released at the top of the building, a more uniform distribution is obtained, but for greater uniformity fans should be used to agitate the air in each room for 1 hour after the gas is released. Once a heavier-than-air gas is uniformly distributed, it does not stratify. Without agitation of the air, fumigants do not readily diffuse throughout a building. Between floors and partitions, between machinery and floors, in closets and cupboards, and in similar dead-air spaces the concentration is never more than a fraction of that in the open air space.

A wagon shed with grain bins on each side of driveway. It is difficult to make single-walled wooden structures tight enough for efficient fumigation. High winds cause severe leakage to occur, a condition which gives small protection to the stored grain.

Effect of Absorption

In a warehouse filled with goods the problem of reaching the insect with a lethal concentration of fumigant is complicated by the type and quantity of the commodity in storage, the method used in stacking, and the size and type of package. After the maximum concentration of gas is attained in a warehouse, the concentration falls, at first rapidly owing to absorption by the commodity being fumigated, and then more slowly owing to further absorption and air leakage. Page and Lubatti (*4*) have estimated that by the end of 24 hours the concentration of fumigant in a warehouse is reduced to a value between ¼ and 1/15 of the maximum. The gas concentration inside commodities being fumigated rises more slowly than, and never as high as, does that in the open space around them.

Type of Commodity

THE factor of sorption is important and must be considered when selecting a fumigant. Each product has a different sorption coefficient. As the particle size of the commodity is reduced, the surface area on which the fumigant can be adsorbed is increased. For example, the surface area available for adsorption in a bag of flour is vastly greater than in a bag of the same size filled with wheat; hence more fumigant is required for flour than for wheat. The absorptive nature of the product is also important. A wheat kernel with its outer coat of bran will absorb more fumigant than a kernel of polished rice.

The rate of sorption also varies with the fumigant used. Lubatti and Harrison (*2*), working with wheat, found that at the end of 1 day the fumigants methyl bromide, trichloroacetonitrile, ethylene oxide, and hydrogen cyanide were sorbed in the proportions of about 1: 2: 6: 17. That is, 17 times as much of hydrogen cyanide was sorbed as of methyl bromide.

The rate of sorption is also affected by the temperature and the moisture content of the commodity. Lubatti and Harrison also found that as the temperature of a product increases, sorption of hydrogen cyanide decreases. On the other hand, with a rise in temperature of 15° C. the sorption of ethylene oxide by wheat is increased 2.7 times, of trichloroacetonitrile 1.8 times, and of methyl bromide 1.6 times. Sorption of hydrogen cyanide is least affected by the moisture content of wheat. Increase of moisture content from 10 to 16 percent increased sorption of hydrogen cyanide only 1.7 times whereas sorption of ethylene oxide, trichloroacetonitrile, and methyl bromide was increased three times. In methyl bromide fumigation of bagged commodities in warehouses it has been observed that insects in any bags that have become wet from roof leaks are likely to escape death. It has also been noticed that in grain bins with a layer of damp surface grain little kill is obtained in the damp grain by ordinary dosages of fumigants.

Proper Stacking of Bags

WHEN bagged commodities of a sorptive nature are closely stacked in a warehouse, it is impractical to attempt to use fumigants other than methyl bromide, owing to the difficulty of obtaining penetration to the center of large stacks. If the commodity is stacked in piles one, two, or five bags deep, the chances of obtaining adequate penetration with fumigants other than methyl bromide are much better. With materials, such as polished rice or corn, that do not have a high rate of sorption, the method of stacking is not so important.

CONCLUDED NEXT MONTH

(Part II will discuss the preservation of farm-stored grain in various parts of the country, fumigation of mills, and certain cautions to be observed in the use of fumigants. Complete bibliography will be presented.)

Experiment Station Digest

By H. H. Slawson

AN intensive investigation to determine the source of bee poisoning in the Yakima valley was conducted by the Washington State Agricultural Experiment Station, at Pullman, last year. An accurate check was made of each case of poisoning reported, covering (1) type of insecticide used; (2) manner of application; (3) distance of dusted fields from affected bee yards; (4) number and species of honey plants dusted accidentally, if any. Samples of poisoned bees were also taken for analysis.

It was found, says the Station's 55th annual report, that cryolite, which is generally supposed to be less toxic to bees, actually caused severe poisoning at times. Rotenone was not used extensively by farmers during the year, so no observations were made on its effects.

In most of the cases the poison was brought to the hive mixed with pollen, and it was felt that most of the damage was done by the poisoned pollen, which destroyed the nurse bees and brood. In dusted potato fields which had no flowers whatsoever, the bees apparently collected the dust in place of pollen.

When it was suggested that weeds and sweet clover in fence rows bordering potato fields be destroyed, growers approved, but beekeepers objected, feeling that this would destroy most of their bee pasture.

No case of bee poisoning was found which could be laid entirely to airplane dusting and where cresol, carbolic acid or nicotine was added to the dust as a repellent, the activity of the bees was stopped for not more than a few minutes.

"The evidence gathered," says the station report, "would indicate that any regulations on the application of toxic dusts drastic enough to lessen bee poisoning significantly would practically put an end to potato growing."

In extensive studies of the spray residue problem at the Washington station, approximately 2,500 analyses were made, covering nearly every type of spray program and combination of spray materials.

Late applications of summer spray oil in excess of 1 qt. of actual oil per 100 gals. appeared to increase residue removal problems, the report observes. Oils heavier than that classified as "light" applied in second-brood sprays, also appeared to increase the problem and excessive amounts of soap spreaders and deposit builders used with some brands of commercial oils, especially in second-brood sprays, and gave a residue hard to remove at harvest time.

An effort was made, says the report, to check the deposit-building ability of various commercial petroleum spray oils with both acid lead arsenate and cryolite. Advantages of the invert type of spray formulas were again demonstrated and, in general, it was found that addition of spray ingredients for mite control reduced the deposit of acid lead arsenate and of fluorine.

Work with DDT for control of cranberry insects was continued at the Cranberry-Blueberry laboratory, with the indicated result that DDT is an effective spray for control of cranberry fireworm and cranberry fruitworm.

"Observations indicate," says the report, "that, although DDT does not kill so rapidly as pyrethrum, many of the sprayed larvae were dead in a few hours. Higher concentrations caused the worms to react more quickly." The season's work also indicated that spray applications three weeks apart gave control comparable to that obtained with pyrethrum when applied weekly.

In an oil solution the DDT spray killed fireworm and fruitworm moths but not so readily as pyrethrum. The report states, also, that a pyrethrum-DDT spray containing 1 qt. of 20 percent pyrethrum concentrate and 20 percent DDT spray powder "is very effective for control of the fruitworm."

Another insecticide, "Piperine," was tested for control of cranberry insects. Used in dilutions of 1 pt. to 100 gals. of water, this compound (piperonyl cyclo hexanol) killed fireworms both in the miller and larval stages and was equally toxic to fruitworm millers. In limited tests it proved superior to pyrethrum or rotenone, but further tests were planned.

Fungicides Tested

FOUR fungicides were tested for control of vine diseases and for fungi that cause losses in stored cranberries. All controlled red leaf spot and rosebloom but two proprietary products, "Copper A" compound and "Fermite," left less residue on the vines. Conclusions were not reported on the tests to determine their relative values on the stored berries.

Extensive losses of Douglas fir seedlings, due to feeding activities of the seed corn maggot, prompted an investigation on behalf of the state's vast lumber industry. Calomel, either as a dust or in suspension in water was not appreciably toxic and the study was shifted to DDT as a possible control. Final data were not available, but the report states that calomel as used in the tests, is definitely toxic to the young fir seedlings.

"However," continues the report, "it does not seem to have the same deleterious effect on Port Orford cedar or spruce. The DDT and carbon disulfide preparations apparently are non-toxic. All three materials are promising controls for the seed corn maggot." For the state's commercial florists, numerous investigations were conducted at the Washington station for control of diseases of tulips, daffodils, lilies and gladioli and definite indications were reported on the relative value of various commercial preparations.

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under way to select one or more materials for seed treatment to prevent decay in the main vegetable crops grown in western Washington. No single material, says the report, is entirely suited for all crops, but an effort was made to determine whether combinations of compounds previously found effective could be used as general treatments on all seeds.

"Results were not so clear-cut as could be desired," the investigators report, "but in general the mixture of 'Arasan' plus 'Spergon' appeared quite promising as an overall treatment. In comparing the performance of individual materials the new U. S. Rubber Co. 'compound 604' was somewhat superior to 'Spergon'." The complete list of products tested included "Arasan," "Semesan," "Spergon," "U.S.R. 604," "Yellow Cuprocide," "Arasan" plus "Spergon," "Arasan" plus "Semesan," "Arasan" plus "Yellow Cuprocide" and "Arasan" plus "Semesan" plus "Spergon."

Seed Pod Weevils

AMONG investigations of vegetable seed pests was one involving the cabbage seed-pod weevil. Promising control materials, as shown by the trials were PCH (pyrethrum and cyclo-hexenone in friamite), "Pyrocide 10," ten per cent DDT dust and synthetic cryolite (both as sprays and dusts). Three compounds which did not appear promising were "Evergreen" (a pyrethrum extract), "B-71" (13.5 percent "Lethane") and 20 percent sabadilla.

Field tests were repeated on three materials shown in previous work to possess control value, resulting in substantiating the earlier work in favor of pyrethrum and lead arsenate dusts. A 3 percent DDT dust gave no control. "Results show," says the report, "that growers can utilize both pyrethrum and the lead arsenate dusts to advantage in reducing their seed losses due to the cabbage seed pod weevils."

Calomel-gypsum dusts gave satisfactory control of cabbage maggot but in observational trials of possible substitutes for nicotine in control of cabbage aphid six compounds proved unsatisfactory. In comparison, a 3.6 percent nicotine dust, unactivated and stored for two weeks in tight containers showed an immediate knockdown and a kill of approximately 95 to 98 percent. The report also comments that airplane dusting indicated a generally inferior cabbage aphid control.

Publications of the Washington station during the year included Bulletin 447, "The Effect of Certain Sprays Upon the Apparent Photosynthetic Activity of Apple Trees," by E. L. Overholser, D. F. Allmendinger and F. L. Overley.

Kentucky Experiment Station's latest annual report notes that 3 and 5 percent DDT dusts, 5 percent DDT in oil and nicotine sulfate were quite effective in removing body and shaft lice from chickens but that DDT in oil and nicotine sulfate seemed superior to the DDT dusts in preventing re-infestation and build-up of body louse populations over a two-month period. Residual effects of all DDT materials on necks of birds appeared to prevent build-up of head-louse populations.

DDT was used in Kentucky tests to control green June beetle larvae with these results: a 20-lb. application per acre killed 65 percent of the grubs; a 40-lb. application killed 57 percent; and a 60-lb. application killed 63 percent. All percentages were considered too low for effective control.

In a large Kentucky orchard DDT was tested as a control for codling moths and where 6 ounces of actual DDT were added per 100 gals. to all sprays in a "arsenate of lead, summer oil and fixed nicotine" program, a crop of apples was produced "over 99 percent free of worms."

Maryland station's report deals with liquefied gas aerosols for pea aphid control. "Aerosols," says the report, "appear to be a highly effective method with many advantages over other methods. Equipment is simple, inexpensive and light in weight. A small amount of labor is required and treatments can be made rapidly."

Most of the obstacles have been overcome, says the Maryland report, adding in support of this statement that "Satisfactory solvents have been added to the aerosol solution which prevent nozzle stoppage caused by recrystalization of DDT at nozzle tips. Container erosion, which also results in nozzle stoppage, has been overcome by addition of organic oxides which neutralize free acids present or resulting from decomposition of DDT. Solutions have been improved to eliminate plant injury; they have also been simplified."

Optimum rate of application, it is stated, appears to be about 8 to 10 pounds of aerosol solution per acre, applied at about 5 to 7 miles per hour. Speeds greater than 8 miles per hour cause mechanical injury to pea vines. Excellent results were obtained when wind velocities averaged 20 miles per hour. A jeep was found too low for carrying spray equipment through tall peas but its four-wheel drive was highly satisfactory.

"Progress in development of aerosols for control of field crop insects, have been highly satisfactory," concludes the Maryland report. "Another season's work should provide necessary information so that this method of aphid control can be recommended to growers."★★

RODENT CONTROL

(Continued from Page 26)

perior to "1080" in efficiency, and that "Castrix" at least, will also be highly dangerous.

The conclusion which must be reached from the review of the developments of the past few years is that new discoveries often come in groups. It is no longer fantastic to hope that toxic agents which will be effective only against the rodent pests may be found soon. It is much more logical now to look forward to a world in which man will be able to keep his communities free of rats, than it was before "ANTU," "1080," and the other new control agents were discovered. A strong research program in rodent control will continue to be a definite adjunct to permanent improvement in the public health, and will be useful in proportion to the degree in which its discoveries are put to use by local and national health agencies.★★

Technical Briefs

Late Blight in 1947?

Plant disease experts at the New York State Experiment station, Geneva, do not expect a repetition of the disastrous late tomato blight which caused severe losses during the past summer. The weather is regarded as the chief factor in finding an answer to the question about the 1947 season.

Continuous drizzly rains with cool nights and exceedingly heavy dews, beginning late in July and continuing through August, along with the early appearance of abundant spores are blamed for the early and widespread outbreak of the disease this past season. So far as is known, the fungus does not live over from year to year on tomato seed, on dead tomato plants, or in the soil. It is known to be present in seed potatoes, however, and to pass readily from the potato to the tomato. It may also be brought in on young tomato plants, such as southern-grown plants as happened this year, or the spores may be blown in from areas where the disease is severe.

Effective control measures are available for those growers who are equipped to spray or dust their tomatoes. Where these measures were applied this season, excellent crops were obtained while in some adjacent fields losses ranged from 90 to 100 per cent.

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Swine Tested for Arsenic

In tests to determine the relative toxicity to swine of lead arsenate spray residue, lead arsenate, lead acetate, and arsenic trioxide, Messrs. Kermit Groves, Ernest C. McCulloch, and J. L. St. John of the Washington Agricultural Experiment stations report that the data obtained from these feeding trials indicated that lead arsenate spray residues are much less toxic to swine than has generally been supposed. (Full report in *Journal of Agricultural Research*, Vol. 73, No. 5, September 1, 1946.)

The authors summarize by saying that one pig consumed the spray residue from 1,007 kg. (2,220 lbs.) of heavily sprayed apples which contained 114.8 gm of lead arsenate in the form of spray residue. This amount is greatly in excess of that which would be consumed by pigs receiving cull apples or pears fed according to commercial practices. Nevertheless this pig gained in weight approximately as well as the control pig. No abnormalities were apparent in the blood studies of the pigs.

Data presented show that of the edible portions of pigs 1 and 2, which were fed large quantities of lead arsenate, only the livers contained more lead than the 7.14 parts per million limit set by the Food and Drug Administration of the Federal Security Agency for spray residue on apples and pears, while none of the organs analyzed contained more than the limit of 3.57 parts per million set for arsenic trioxide.

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Selenium as Repellent

Recent research by R. G. Fuller, of Battelle Institute, Columbus, Ohio, and Dr. D. C. Kiplinger, of Ohio State University indicates that the addition of small quantities of selenium salts to the soil around plants, may cause the plant's foliage to be toxic to such pests as red spider mites, aphids, and thrips. Following months of experimentation with various selenium salts, it was found that applications of sodium selenate in the ratio of about one-half gram per square foot of soil surface was a complete control of certain pests on chrysanthemums and partial control for others. It was noted, however, that if the plants are already badly infested at the time of selenium application, some other control measure may be necessary in the initial period, before an effective concentration has been reached in the plant. Plants tested in addition to chrysanthemums were carnations and hydrangeas, and the insects studied are common greenhouse pests.

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Flea Hopper Control

Technical Bulletin T-24, dated October, 1946, is issued by Oklahoma Agricultural Experiment Station, Stillwater, discussing control methods on the cotton flea hopper in that state. Authors are Charles H. Brett, R. R. Walton, and E. E. Ivy, of the department of entomology.

It is pointed out how since 1936 research has been conducted against the pest which is most prevalent in the southwestern part of Oklahoma where most of the cotton is grown. There appears to be a relationship between rainfall, plant succulence, and the prevalence of hosts, the infestations being greater in the presence of these factors.

During a period of five years, tests were made to determine the most satisfactory dusts, their rate of application, and the economic value of control. During this period a total of 25 tests were made, each replicated three or four times. There was a difference of only 8.4 pounds of seed cotton per acre between the treated and non-treated plots. Good control of the flea hopper was obtained, but its advantage did not appear in yields. This is believed due to the plant's ability to compensate in various ways for any loss of squares caused by flea hoppers. Under the growing conditions of southwestern Oklahoma, considerable shedding is caused by variation in light intensity, high temperatures, and drouth. Flea hopper influence is a factor which would not normally add to this usual climate effect. Plants balance their development and reach a point wherein they are supporting all of the bolls they are able to mature. This usually is reached in August. When forms were removed from plants during August, they responded with a greatly increased vegetative development and vigor, but were unable to recover their fruit in time for boll maturity.

DDT was found to give excellent control, but was not effective against adult flea hoppers except at the higher concentrations. Three per-

cent DDT reduced the adults 47 percent, 5 percent DDT reduced them 55 percent, and 10 percent DDT reduced them 92 percent.

Because of the comparatively high price of DDT, it would not replace sulphur in the event control were deemed advisable. The addition of Paris green or calcium arsenate to sulphur at the rate of 1 part in 2 parts greatly increased control of adult insects. Other insecticides tested were less effective than DDT or sulphur.

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Fertilizer for Cotton

U.S.D.A. Circular No. 726 by Dr. J. J. Skinner tells how cotton production in the U. S. was increased nearly two and a half million bales in a single year through the use of commercial fertilizers. "In more than 150 experiments . . . on the principal soil used for cotton production in seven states and covering the range of 18 years, the average increase of cotton due to fertilizers, used at rates of 200 to 600 pounds per acre, is approximately 1.6 bales per ton of fertilizers; that is, 40 pounds of lint per 100 pounds of fertilizer. . .

"A larger percentage of cotton produced by fertilizers is attributed to nitrogen than to phosphoric acid or potash. In general 50 to 55 per cent of the increase may be attributed to nitrogen, 15 to 20 per cent to phosphoric acid, and 25 to 30 per cent to potash."

"Approximately half of the nitrogen used on cotton is applied as a side-dressing after the cotton is up. Without an adequate supply of available nitrogen, cotton plants fail to grow and produce well . . . An adequate supply of nitrogen produces rapid growth, dark foliage, and early setting of squares and bolls."

"One important effect of phosphate is to hasten the maturing and opening of cotton . . . Without sufficient available potash, cotton plants show reduced vigor and are more susceptible to disease . . . Potash reduces loss of cotton from wilt . . . is effective in controlling rust of cotton . . . increases the percentage of oil in the cottonseed."

Grasshopper Data

Investigating grasshopper control problems, two Montana State College entomologists, Profs. J. H. Pepper and E. B. Hastings, have reached the conclusion that there is an important relationship between the intensity of the sunlight, air temperature, body temperature of the grasshopper and where and when this pest does its eating.

Next step was to find some way to take the grasshopper's temperature and the result was development by General Electric Co. of a special electric thermocouple, 5/1,000th of an inch in diameter, which can be inserted into the bug without damaging its delicate tissues. General Electric, in announcing the development, quotes the entomologists as explaining that a grasshopper's body temperature may be 18 to 22 degrees Fahrenheit higher than the surrounding air temperature, depending on the sunlight intensity, and that the insects will die if their body temperature reaches 120 degrees F.

The 'hoppers instinctively know what is best for them, the two Bozeman entomologists claim. If air over wheat fields is cool, the insects will likely be feeding in a location where they would absorb considerable sunlight. If the air is hot, the pests will naturally seek a shaded area for their feeding, in order to avoid direct sunlight. Armed with this "know how," it is intimated, the farmer will be able to locate his grasshopper enemies, during varying weather conditions, and can spread his poison baits where they will do the most good without wasted effort.

•

Semicarbazones Tested

In a recent U.S.D.A. bulletin (E-705, October, 1946) S. I. Gertler of the Division of Insecticide Investigations presents a review of laboratory tests on the toxicity of certain semicarbazones to various insects. All compounds were considered toxic to leaf-eating insects if they gave at least 75 per cent kill. In the case of the codling moth, those that gave less than 50 per cent of wormy fruit were included. For the screwworm all compounds having a minimum lethal concentration of 0.1 per cent were chosen. Other results were selected on a similar basis.

The following list includes all semicarbazones that were definitely toxic to one or more insects and the number of species to which each was toxic:

Semicarbazone	Number of species
Cyclohexanone	8
4-Methylcyclohexanone	8
p-Chloroacetophenone	7
Cyclopentanone	6
2,4-Dimethyl-3-pentanone	6
Ethyl methyl ketone	6
2-Furaldehyde	6
2-Methyclyclohexanone	6
2-Heptanone	3
Acetophenone	2
Benzophenone	2
2,6-Dimethyl-4-heptanone	2
Levulinic acid	2
Methyl propyl ketone	2
2-Octanone	2
p-Aminobenzophenone	1
Benzaldehyde	1
Crotonaldehyde	1
alpha-Ethylbutyraldehyde	1
2-Methylacetophenone	1
Salicylaldehyde	1

It is noteworthy that, of the 33 semicarbazones tested, 21 showed definite toxicity to 1 or more insects. Of the 8 most toxic compounds, 4 are semicarbazones of cyclic aliphatic ketones, and they were the only compounds of this group which were tested. Aside from these, no particular group stands out. However, there seem to be some differences in toxicity exhibited by small differences in composition in some groups. For example, of 7 semicarbazones of ketones containing an aromatic group, p-chloroacetophenone semicarbazone was found to be the most effective. 3,4-Dichloroacetophenone semicarbazone was entirely ineffective, and other substituted acetophenone and benzophenone semicarbazones were not so toxic as acetophenone and benzophenone themselves.

Of 7 aliphatic ketone semicarbazones, 5 showed some toxicity, and 2 of these, 2,4-dimethyl-3-pentanone semicarbazone and ethyl methyl ketone semicarbazone, were among the most effective materials tested.

In general, it may be concluded that semicarbazones as a group show promise as insecticides against selected insects.

TO SERVE YOU BETTER AND *FASTER*

Strategically located across the Nation, eight plants help Pennsalt give the best of service to agriculture... the kind of service agriculture wants and needs. These plants and the services they offer are:

1. **PITTSTOWN, N. J.:** Pennsalt's original DDT manufacturing plant, engaged in the production of DDT Technical.
2. **CORNWELLS HEIGHTS, PA.:** Penco DDT insecticides, Penite chemical weed killers, Kryocide natural cryolite insecticide, Penco Grain Fumigant are warehoused here.
3. **EASTON, PA.:** Home of Penco Solvent Concentrate and Penco Emulsion Concentrate . . . both DDT products.
4. **NATRONA, PA.:** Most important of the Pennsalt plants connected with agricultural chemicals. Produces Kryocide, DDT Technical, Penco DB-50, Penco WB-50 and Penco Cattle Spray . . . the last three all being DDT insecticides.
5. **WYANDOTTE, MICH.:** At this, Pennsalt's largest plant, Penco Grain Fumigant is produced and warehoused.
6. **BRYAN, TEXAS:** Produces and distributes Penco Calcium Arsenate and mixtures, also DDT bases and mixtures.
7. **TACOMA, WASH.:** Penite chemical weed killers are made here. In addition, this plant serves as sales office for 11 Western States.
8. **PORTLAND, ORE.:** Manufactures Sodium Chlorate weed killer.
9. **WHITEMARSH RESEARCH LABORATORIES**—Pennsalt's spacious new research center, where exploration for new and better agricultural chemicals is a continuing project.

Pennsalt's line of agricultural chemicals includes a product for most agricultural needs. For full information about these products, write our Agricultural Chemicals Division.

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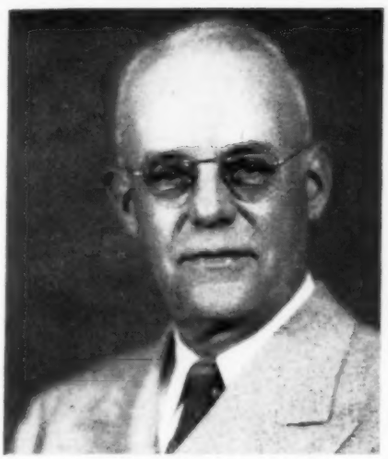
INDUSTRY NEWS

Dr. Parker to Argentina



Dr. J. R. Parker, U.S.D.A. grasshopper control expert is in Argentina upon request of the government of the South American country which is experiencing a severe grasshopper outbreak.

Manufacturers of the United States have furnished experimental lots of new insecticides to be used by Dr. Parker. Most of these materials have been tested by him during the recent grasshopper season in the United States, and showed considerable promise. Among these are benzene hexachloride, a chlorinated camphene and a chlorinated hydrocarbon which will be tried out under Argentine conditions.

Dr. Parker has been fighting grasshopper infestations since 1910. He has been the leading grasshopper control researcher for the Bureau of Entomology and Plant Quarantine for the past 16 years, and his research activities have contributed largely to the high degree of grasshopper control in the United States.

•

Julius Hyman & Co. Formed

Dr. Julius Hyman, formerly executive vice-president of Velsicol Corp., Chicago, who resigned this post a few weeks ago, has just organized Julius Hyman & Co., with headquarters in Denver, Colo. Dr. Hyman is president of the new company which will manufacture a chlorinated hydrocarbon insect toxicant of the formula C_{10} H_6 Cl_8 to be sold under the name "Octa-Klor." An eastern sales office has been established at 11 West 42nd St., New York. This office will be headquarters for J. Newton Hall, sales manager of the company, and Dixon C. Van Winkle of the sales staff. Mr. Hall was formerly in charge of the New York sales office for Velsicol Corp.

Associated with the new company as entomologist, is W. E. McCauley who was formerly with Velsicol Corp. Another member of the Hyman executive staff is Lloyd M. Joshel who has been named general purchasing agent. E. Despres, formerly advertising manager of Velsicol Corp., is advertising director of Hyman & Co.

•

N.A.I.D.M. in Convention

The National Association of Insecticide and Disinfectant Manufacturers, Inc., held its annual meeting December 2, 3 and 4 at the Commodore Hotel, New York.

The preliminary program included discussions of various insecticides and other pest control materials applicable to the agricultural field. Association president N. J. Gothard of the Sinclair Refining Co., opened the session with an address of welcome, and later in the morning Dr. Alfred Weed of John Powell & Co., New York, spoke on benzene hexachloride.

Discussion of the proposed uniform state insecticide and fungicide model bill was presented by W. J. Zick of B. Heller & Co., Chicago; and the rodenticide "Antu" was described in a talk by Dr. James C. Munch of Munch Laboratories, Upper Darby, Pa. An aerosol symposium was held under the chairmanship of John H. Mills, Bridgeport Brass Co., Bridgeport, Conn. Taking part in this portion of the program were Dr. E. R. McGovran and J. H. Fales of the Bureau of Entomology and Plant Quarantine, U.S.D.A., Beltsville, Md.; Clement H. Watson of J. Walter Thompson Co., New York; and Dr. Waldemar Dietz, of the Bridgeport Brass Co.

Thorne to Sherwin-Williams

Sherwin-Williams Co., Cleveland, has announced the appointment of G. Gilbert Thorne as general sales manager of the company's special products sales. Mr. Thorne for the past 11 years was connected with the Montgomery Ward Company as manager of its paint, oil and chemical division.

•

Entomologists Meet

The American Association of Economic Entomologists was scheduled to hold its 1946 meeting December 9 to 12 in a joint session with the Entomological Society of America. The gathering, originally planned to be held in Pittsburgh, Pa., was later announced as being at Richmond, Va.

Program committeemen, acting for both societies, were A. M. Boyce of the University of California, G. J. Haeussler of the Insect Pest Survey of the Bureau of Entomology and Plant Quarantine, U.S.D.A., Washington, and Dr. Charles E. Palm, head of the Department of Entomology, Cornell University.

New Co-op Building

Cooperative Plant Food, Inc., Indianapolis, Ind., expects shortly to start the pouring of concrete for the foundation of a modern plant in the city, to produce superphosphate for its farmer members in four states. Building and equipment will cost about $500,000, according to Marvin J. Briggs, president of the organization. Productive capacity, when completed and in operation next summer, will be around 500,000 tons per year, he said. Owners of the project are co-operative groups of farmers in Indiana, Illinois, Wisconsin and Minnesota.

•

Gammexane is Needed

American firms interested in furnishing quantitites of "Gammexane" (benzene hexachloride) to the Greek Ministry of Agriculture to help fight a serious outbreak of locusts in Greece, are invited to submit particulars to the Greek Embassy, Office of the Commercial Attache, 2221 Massachusetts Ave., N.W., Washington, D. C. Details should include price and delivery date. The locust invasion in Greece has reached proportions of a "plague," it is indicated.

•

Gustavus Ober, Jr., Dies

Gustavus Ober, Jr., 65, president of the former fertilizer manufacturing firm of G. Ober & Sons Co., Baltimore, and former president of the National Fertilizer Association, died in Baltimore on November 10. Mr. Ober, a life-long exponent of private enterprise in the fertilizer industry, had opposed government participation in the industry, particularly in the operation of Muscle Shoals projects in the south.

•

N. E. Phytopaths Meet

The first meeting of the new Northeastern Division of the American Phytopathological Society was held at Amherst, Massachusetts November 26 and 27. The group was formerly known as the New England Division, but was recently reorganized to include the states of New York, New Jersey, and Pennsylvania in addition to the New England states. The annual meeting of all the divisions of the American Phytopathological Society is scheduled to be held in Cincinnati December 28, 29 and 30 at the Netherland Plaza.

•

Asquith Opens Office

Dean Asquith, formerly coordinator of agricultural experimentation and sales, Rohm & Haas Co., Philadelphia, has opened his own office as an insecticide consultant in Amherst, Massachusetts. The location is 18 Nutting Avenue.

•

Wilde to Griffin Co.

Griffin Chemical Co., San Francisco, has announced the appointment of T. E. "Ed" Wilde to the firm's technical service and process development staff. Mr. Wilde, a graduate of Stanford U., has for the past 15 years acted in various capacities for technical departments of the Union Oil Co., most recently as assistant to the manager of the Chemical products division in Los Angeles.

Insecticide Mixers—

get proven DDT formulations and dependable DDT facts from Geigy

The use of GESAROL* and NEOCID* DDT compositions in your insecticides is assurance that you are incorporating the best possible DDT formulations — formulations which can be extended effectively and economically to the desired strength in both dusts and sprays. They are backed by *proven* performance.

Availability of full cooperation from the Geigy Company, *Originators of DDT Insecticides*, promises assurance of the latest and most authentic facts covering the profitable use of DDT.

In short, *when you deal with Geigy,* products and facts based on nearly eight years of all-out research and development are at your service.

* * * * * * * * *

Geigy can supply GESAROLS and NEOCIDS to meet your rigid specifications covering purity, strength and uniformity. Our sales and technical staff welcome the opportunity to co-operate with you.

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* *Reg. U. S. Pat. Off.*

GEIGY COMPANY, INC.
89 BARCLAY STREET, NEW YORK 8, N. Y.
Originators of DDT Insecticides

N.P.C.A. Elects Sturgeon

J. Harvey Sturgeon, of Sturgeon Pest Control Co., Louisville, Ky., was elected president of the National Pest Control Association at the 14th annual convention of the group at New Orleans in October. Mr. Sturgeon succeeds Theodore Oser of the Orkin Exterminating Co., Atlanta, Ga.

More than 600 pest control operators attended the New Orleans meeting. A series of symposia constituted the main body of the three-day program in which were included numerous well-known authorities representing both government and industry. The association voted to hold its 15th annual meeting (1947) in Philadelphia.

•

Co-op Studies Insecticides

Farmers Union State Exchange, Omaha, Nebr., is asking its farmer-members for their ideas on containers for packaging weed killers, DDT, stock dips, fly sprays and other agricultural chemicals distributed by this farm supply cooperative.

"Farm people do not go in for small packages, because they are likely to be expensive," says Wilbur M. Jenny, manager of the Exchange's chemical department, in inviting suggestions on packaging from the organization's patrons.

•

Discuss Airplane Spraying

Some 200 persons were present at the November 8th meeting of the California Entomology Club, held at the State College of Agriculture, Davis, Calif. The topic of discussion was airplane application of insecticides. Many of those attending were connected with the Airplane Crop Dusting Association which itself claims a sizeable membership firms and individuals in the business.

•

Nebraska Weevil Fight

Farmer cooperatives throughout Nebraska are reporting a heavy run on their stocks of fumigants for treating insect-infested grain stored on farms. Much wheat after harvesting was placed in farm storage bins while still damp and heavy infestation of weevils followed. This condition is not confined to any one section but seems to be general throughout Nebraska's wheat raising area according to hastily made surveys.

•

Joseph N. Tosh Dies

Joseph N. Tosh, 50, a foreman at the American Agricultural Chemical Co., Carteret, N. J., died November 10 at Scotch Plains, N. J. Mr. Tosh had been with the company for the past thirty years. He was a native of Maryland, and a graduate of Cooper Union, New York.

Micro Nu-Cop

A fixed neutral insoluble micronized* tribasic copper sulphate containing 53% metallic copper for dusting or spraying. No lime required—extremely fine particle size, 2-5 microns.

*Trade Mark registered U. S. Patent Office by Micronizer Processing Company, Moorestown, N. J.

AVAILABLE
From One Source:

A complete list of agricultural products for the dealer backed by nearly a quarter century of experience in serving the industry:

Agricultural Insecticides
Fungicides
Seed Protectants
Fertilizers
Weed Killers
Feedstuffs
And allied materials

☆

Modern well-situated warehouse facilities, a technically trained staff and experienced local representatives enable Faesy & Besthoff to provide efficient, economical large-scale distribution for leading manufacturers.

All products offered by this organization have proved their value under actual field conditions.

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FAESY & BESTHOFF, Inc.

Chemicals for Agriculture

220 E. 42nd Street — New York 17, N. Y.

WEEDS THAT FLAVOR MILK *cost dairymen millions!*

Baker's 2,4-D

KILLS COSTLY WEEDS—HELPS BUILD VALUABLE PASTURAGE—GIVES MORE GRAZING PER ACRE!

Off-flavor milk is costly. Every year milk plants and creameries reject or degrade a large quantity of milk and cream with weedy flavors. It costs dairymen millions of dollars.

To prevent off-flavors in milk, cows must be taken off pastures containing "flavor weeds" four hours before milking—in some cases longer. This means considerable loss of valuable pasturage to the dairyman.

Many of the troublesome weeds which cause off-flavors in milk can be killed with 2,4-D—wild onion or garlic, bitterweed, French weed, dog fennel, ragweed, shepherd's purse, wild mustard, and pepper grass.

Killing these weeds makes more pasture available for the dairy herd and reduces off-flavor milk losses to the minimum.

To those who formulate weed killers, here is a real opportunity to create sales. The J. T. Baker Chemical Company supplies your needs two ways—raw materials for manufacturing weed killers such as acid 2,4-D and the sodium salt of 2,4-D, which is water soluble.

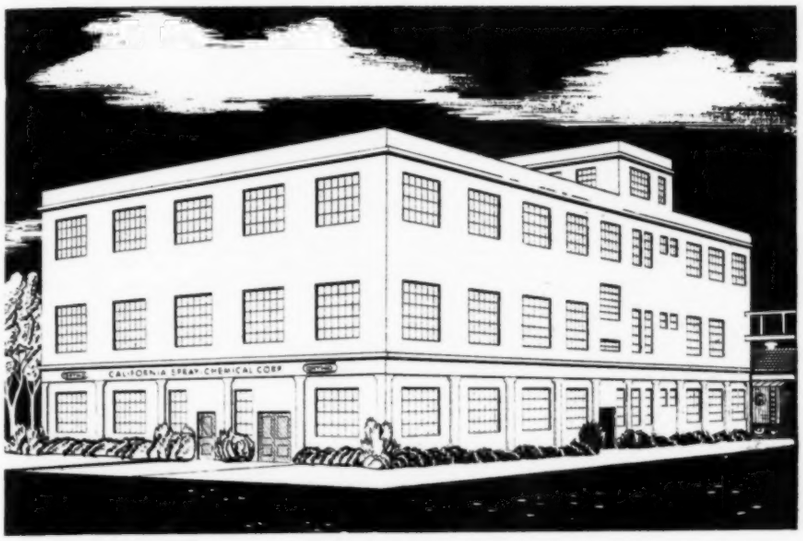
OR, you can obtain Baker's 2,4-D formulated concentrates which are ready for dilution by the consumer and ready for your trade-mark and label.

Whether you are interested in either or both, write for further facts and prices. Address Organic Chemical Division, J. T. Baker Chemical Co., *Executive Offices*, Phillipsburg, N. J.

Baker's Chemicals

C. P. ANALYZED • FINE • INDUSTRIAL

California Spray-Chemical Co. Expands



The California Spray-Chemical Corporation of Richmond, has added to its facilities some 50,000 square feet of manufacturing floor space in the acquisition of a three-story building which formerly housed the Sun Maid Raisin Growers' Association in Fresno.

This new unit will be used in the manufacture of the company's "Ortho" dusts, and will also mix special dusts on order. In addition to the manufacturing facilities, storage space is provided for quantities of liquids, oils and chemicals. The company plans to serve from this warehouse, the scientific pest control requirements of Kern, Kings, Tulare, Inyo, Fresno, Madera, Merced, Mariposa, Stanislaus, Tuolumne, and Mono counties of California.

•

B.E.P.Q. Booklet on DDT

"DDT and Other Insecticides and Repellents Developed for the Armed Forces" is the name of miscellaneous publication No. 606 of the United States Department of Agriculture. The 70-page book is the result of 3 years of intensive investigations at the Orlando, Fla., laboratory of the Bureau of Entomology and Plant Quarantine on the control of insects of importance to the armed forces. The report was originally written and issued in mimeographed form for the specific use of the armed forces and others concerned with the problems of controlling insects and insect-borne diseases affecting military personnel and civilians in occupied territories.

•

PYRETHRUM STORY

(*Continued from Page* 29)

on the basis of 1.3% pyrethrins and all shipments are analyzed at destination and final payment made on landed analysis. Samples taken at Nakura, while the flowers are being passed into the presses, are bulked and finally a sample representing a 20 ton lot of flowers is analyzed at the Scott Agricultural Laboratory near Nairobi, and a certificate of pyrethrin content is issued to ensure that flowers test 1.3% pyrethrins before shipment.*

Locally, pyrethrum is in constant demand from coffee growers as an antidote against antestia — a destructive insect of the ladybird species speckly in color—which does much damage to the young coffee leaves and buds. Recently, too, pyrethrum has been found most effective against the "cuckoo-spit," a harmful virus found on sugar cane in Kenya. In certain parts of the Colony the incidence of malaria is very great and here the medical authorities have conducted successful anti-mosquito campaigns by dusting pyrethrum powder in the native dwelling houses. A large number of Africans are employed in the grading, handling, baling and powder manufacturing processes at the headquarters of the pyrethrum industry at Nakura. Here, it is interesting to note, the Government medical authorities report that the health of the workers is of a higher standard than of natives working in other industries. Skin and eye diseases are reported to have disappeared almost completely from workers, which would seem to indicate an unexplored line of research for new uses for pyrethrum. The Pyrethrum Board of Kenya, in active collaboration with the Kenya Government, pursues a policy of research in pyrethrum plant breeding and agronomy, and several experimental stations for this purpose have been erected at varying altitudes throughout the Kenya Highlands.

Some insecticide manufacturers in the United States believe that the insecticide market is only beginning to scratch the surface. What then is the future of Kenya pyrethrum? As in the case of rubber, scientists have turned their efforts to finding substitutes for the natural insecticide, pyrethrum. Research in this direction has been going on for many years and, as a result, several synthetics have been evolved. However, none have yet been able to compete with pyrethrum's combination of knock-down and kill towards insect pests and complete safety towards man and animals.★★

*A current heated discussion is in progress between American importers and the Kenya Farmers' Association over refunds due American importers for shipments of flowers received during the past year which did not measure up to the 1.3 content guarantee. Although American importers purchased these flowers from the K.F.A., it has been disclosed that actually the British Ministry of Supply is involved and, so far, the British Ministry of Supply has refused to pay the American importers the amount due them under the terms of the American contract with the K.F.A.

The industry hopes that this dispute will be concluded at any early date so as not to impair the very close friendly relations which have always existed in the past between the Kenya Farmers' Association and the American importers.

•

Caldwell to N. C. Post

Harry B. Caldwell has resigned as secretary-treasurer of the American Plant Food Council to accept a position as executive secretary of the newly-formed North Carolina Good Health Association, with offices in Durham, N. C.

Velsicol Elects New Officers

F. P. Schneider

A. R. Jameson, Vice-Pres.

Velsicol Corporation, Chicago, announces the election of F. P. Schneider as president and general manager, succeeding Julius Hyman, executive vice-president who recently resigned. Mr. Schneider was elected at a special meeting of the board of directors.

The new president has been secretary and treasurer of the Velsicol Corporation since its founding in 1931. Previously he had been prominent in the paper manufacturing and oil refining fields. His immediate plans for Velsicol include the expansion of manufacturing facilities to take care of anticipated demands for the company's line of core oils, synthetic resins, aromatic solvents as well as its insect toxicant solvents. The new Velsicol insecticide, "1068" also occupies a prominent place in the planning.

Vice-president and general sales manager, A. R. Jameson, continues in his former position with Velsicol. He will direct sales and act in an executive capacity for the corporation.

•

Turner to Dodge & Olcott

Dodge & Olcott Inc., New York, announces the addition of Maurice B. Turner to the technical sales staff of its insecticide division. Mr. Turner was formerly with Dow Chemical Co. in its Dowicide Division, Midland, Michigan. He later came east to be connected with Dow's eastern branch.

With Dodge and Olcott, Mr. Turner is contacting insecticide users in a program of sales development work, as a technical sales representative. He is a graduate of North Dakota University, Grand Forks, North Dakota.

Good News....

FOR AGRICULTURAL ZINC USERS

Attention Distributors:

We now offer in carload quantities our ZINC COMPOUND 38% Zn for use in Agricultural Zinc Sprays and in nutritional Zinc applications. This product is composed of various Zinc components blended to give a uniform non-hardening product which is easier to handle than some Zinc materials. It has been tested and is used in Florida to correct Zinc deficiency. Many carloads have been used for this purpose with complete satisfaction.

Used with complete satisfaction in Georgia and South Carolina in formulas containing Arsenate of Lead. If you sell Zinc for Agricultural applications write for details and samples.

Prompt carload shipments

W. R. E. ANDREWS SALES COMPANY

1505 Race Street — *Agricuttural Chemical Specialists Since* 1926 — Philadelphia 2, Pa.

NEW EQUIPMENT

(*Continued from Page* 19)

ducing these liquids into the soil consist of a chisel type cultivator with standards spaced from 15 to 18 inches apart. Tubes for carrying the fumigant into the ground are welded onto the trailing edge of the cultivator standard. The liquid is metered to dispensing tubes by either positive displacement pumps or by means of air pressure in a pressure tight tank containing the toxic material (this method is used only for non-flammable materials).

Livestock Spray Equipment

SPRAYING cattle and sheep for control of oxwarble, lice, ticks, etc., has gained widespread usage during recent years. Small portable orchard sprayers and hand operated guns have been used generally for this job. Shortly after this practice started, livestock men began to question the advisability of using dipping vats. We now find several commercially built portable spray-chutes available which do replace the old dipping vat. In general the spray-chute has a piping system along its bottom, sides, ends, and top. From 20 to 25 nozzles are located on this piping system at such positions that spray is directed towards the animal from all angles. A centrifugal pump capable of delivering up to 125 GPM at pressures up to 40 psi is usually employed. The run off from the animals being sprayed, returns to a sump where it is recirculated through the reservoir tank. Recirculation from the pump provides adequate agitation for any of the suspension type mixes. The spray-chute permits much more efficient use of chemicals, it is faster than dipping and is much less likely to cause livestock injury. Furthermore its portability permits it to have a much higher annual use than a vat.

In this brief description of some of the many types of equipment now being used for control of agricultural pests, it should be emphasized that much work remains to be done. Conditions are changing rapidly and development of pest control equipment must be accelerated to keep up with progress in agriculture.★★

Velsicol Enters "1068" Suit

Velsicol Corporation, Chicago, manufacturer and distributor of the insecticide "1068," has filed suit in the Superior Court of Cook County, Illinois, against Dr. Julius Hyman, formerly an officer of that corporation. In the suit, Velsicol Corporation alleges that Dr. Hyman made certain applications for patents in his own name covering inventions which the Velsicol Corporation claims are in fact the sole property of the Corporation. The Velsicol Corporation asks that Dr. Hyman be required to assign and turn over to it the patent applications.

In addition to making the foregoing announcement, the Velsicol Corporation also stated: "There will be no interruption in the expansion of Velsicol's research and production facilities for the manufacture of 1068 or any of its other products."

● If other charms fail, the Dyaks resort to making a clay crocodile as large as life and setting it up in the fields, where they offer it food, rice spirit and cloth, and sacrifice a fowl and a pig before it. It was the belief that, mollified by these attentions, the ferocious animal very soon would gobble up all the creatures that devoured the crops.

CHARMS AND MAGIC WERE A FAILURE

FROM the dawn of time, man has waged a continual warfare against crop pests. In the early days, even charms and magic were employed extensively. Today's growers of fruits and vegetables do not rely upon ancient hit and miss methods... they avail themselves of the rapid advances made by our scientists in producing today's effective dust and spray materials, and the machinery for applying them.

Niagara Sprayer and Chemical Division has constantly kept pace with this rapid development. Constant research has brought about greater efficiency in control through *combinations* of materials during the season. Pest control programs are far more thorough than in the early days, but the resulting bigger and better food crops are a rich reward.

Some of the control materials developed by Niagara are its Kolo products (Bentonite-Sulphur), arsenicals (lead and calcium), copper products, rotenone combinations, nicotine dusts, organic insecticides, fungicides and herbicides, hormone dusts and sprays, dormant sprays, and the most modern dusting equipment for applying dry insecticides and fungicides. Niagara has always lived up to the slogan contained in its trade-mark: "When you buy Niagara, you buy protection."

WHEN YOU BUY Niagara YOU BUY PROTECTION

NIAGARA SPRAYER AND CHEMICAL DIVISION
FOOD MACHINERY CORPORATION
MIDDLEPORT, NEW YORK

Richmond, California • Jacksonville, Florida • Pompano, Florida • New Orleans, Louisiana
Greenville, Mississippi • Harlingen, Texas

Canadian Associate: NIAGARA BRAND SPRAY CO., LTD., Burlington, Ontario

Powell and only Powell

for you the risk before you buy

IT WILL PAY YOU TO INVESTIGATE THESE

Powco CHEMICAL INSECTICIDE CONCENTRATES

HOUSEHOLD INSECTICIDE CONCENTRATES

Pyrethrum and DDT base insecticide concentrates for every household use. Investigate Pyrin — pyrethrum concentrate with added killing power; synergized with Sesamin.

AGRICULTURAL INSECTICIDE CONCENTRATES

There is a Powco Brand insecticide concentrate for every agricultural use. DDT, Pyrethrum, Rotenone and Sabadilla products. Name your insecticide problem and we'll name the insecticide.

RODENTICIDES

Powco Brand ANTU—Alpha Naphthyl Thiourea—the new wonder rodenticide. Economical, effective and deadly. Acceptable to rats, easy to use in baits, on water or as a tracking poison.

HERBICIDES

2,4-D (2,4-dichlorophenoxyacetic acid) in four Powco formulations for the latest in selective weed killing. Let Powell solve your weed control problems. Investigate Powco Brand 2,4-D.

AEROSOL FORMULAS

Powell has specialized in aerosols since the first aerosol bomb. Completed aerosol formulas with Pyrin, Sesamin and DDT—high or low pressure.

HOW WE REMOVE THE RISK

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Company .....

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American Petroleum Institute Discusses Role of Insecticides at Chicago Meeting

DURING 1945 some 75 million gallons of petroleum distillates were utilized by manufacturers of insecticides for use by the general public, according to Arthur W. Turner, assistant chief in charge of agricultural engineering research in the Dept. of Agriculture's Bureau of Plant Industry, Soils and Agricultural Engineering.

The amount used in addition by the armed services during the same period, is not known, he added, in addressing an agricultural group session during the American Petroleum Institute's November meeting in Chicago. However, one South Pacific division, alone, he stated, used 250,000 gallons of fuel oil as a solvent for DDT which was applied for malarial control on various occupied islands in the same period.

These facts Mr. Turner cited, among others, to emphasize that the petroleum and agricultural industries have much in common. "Many advances are being made in insecticides," Turner continued. "Discovery of such new and highly effective organic insecticides as DDT, benzene hexachloride and others may, of course, have distinct effects on such uses of petroleum products. What this effect may be cannot now be accurately foreseen. It does not seem likely, however, that these products will be totally replaced.

Much of the progress in agriculture has been made because of research, Mr. Turner remarked, as he outlined the expanded research program which will be made possible through the Marketing and Research Act, signed by the President in August. This act, he said, authorizes $9,500,000 for the 1947 fiscal year and progressively larger amounts in each of the five following years. As yet no funds have been appropriated, he said.

John L. McCaffrey, president of International Harvester Co., Chicago, commended the program of study of insecticides, fungicides and other chemicals for control of crop and plant diseases and pests, recently launched by the Petroleum Institute's newly created Agricultural Development Committee.

While much has already been accomplished in developing petroleum bases for these materials, he said, much remains to be done. "Such devastating pests as the cornborer and the Japanese beetle are still relatively uncontrollable," he pointed out.

Outlining the proposed program of the Institute's agricultural development committee, its chairman, George Krieger of the Ethyl Corp., New York, said close cooperation will be developed with the insecticide and fungicide industry as a leading supplier of basic materials. Catalytic cracking of crude oil, Mr. Krieger said, has produced a wide variety of toxic compounds, some of which have proven to be destroyers of insects, weeds, plant fungi and other farm pests.

Insects, he said, are destroying $2,000,000,000 worth of farm crops every year and plant diseases add another $1,000,000,000 to the debit side of the food ledger. "If the new petroleum-based toxic compounds and the new synthetic hormones do the job everybody hopes they will do, then something constructive for the world has been accomplished," he asserted, and continued: "We want to be able to point out not only the benefits of the new insecticides, fungicides and weed destroyers. We want to be able to tell the farmers 'Use it here, but not there.' We want to be able to tell them how best to apply the compounds; to tell them whether to use a spray—and, if so, what kind of a spray—or a dust or fog or combination of both, or what not.

"Until we can advise the farmer thus and with a reasonable degree of confidence in what we are saying, we do agriculture a disservice in making any new products available. . . . Agriculture can go forward or backward, depending to a large extent on how we, its suppliers, lend it the benefit of our accumulative knowledge in the next decade."

Aerosol for Greenhouses

Edco Corporation of Newark, Delaware, announces a new 5-lb. aerosol bomb for greenhouse use. The applicator features a flexible 24-inch hose onto which is connected a copper nozzle rod also 24 inches long. The hose is plastic lined and rubber covered. The bomb itself is supported by a shoulder strap. An operator can cover about 10 feet on each side of the aisle by waving the nozzle end from side to side as he walks. Operator can walk out from under the fumes and not be exposed to them.

•

New Agency Formed

Paul Koons, former special representative of the agricultural chemical division of Miller Chemical Co., Omaha, Nebr., has announced the organization of his own brokerage agency in Omaha. The new agency will handle sales of agricultural chemicals and spray equipment to insecticide and fungicide manufacturers and chemical jobbers.

•

S-W Advances Kohr

Donald A. Kohr, Jr., has been appointed Technical Director of Special Chemical Products of the Sherwin-Williams Co., the company announces. Mr. Kohr was formerly director of the firm's emulsion research laboratory in Chicago. He has been with the company since 1932.

His new work puts him in charge of research and the development of Sherwin-Williams' line of special chemical products which include "Weed-no-more," 2,4-D weed killer, and "Pestroy" DDT products.

The Listening Post

This column is prepared especially for readers of AGRICULTURAL CHEMICALS. Mr. Haeussler is in charge of Insect Pest Survey and Information, Agricultural Research Administration, Bureau of Entomology and Plant Quarantine, U.S.D.A. His observations, based on latest reports received by the Bureau from collaborators all over the country, is a monthly feature of AGRICULTURAL CHEMICALS.

By G. J. Haeussler

DURING the period from October 15 to November 15 few reports were received of insects requiring insecticides for control other than those attacking vegetable and truck crops. The more important records, which concern chiefly the southern parts of the country, are summarized below.

Moderate to heavy populations of cabbage caterpillars have continued to occur on cabbage and related crops in parts of South Carolina, Georgia, Florida, and Louisiana, especially on plantings which have not received adequate insecticide applications. They have continued in light to moderate populations on cole crops in Virginia, Alabama, and California. Good results from the use of DDT against these pests have been reported from South Carolina and Florida.

The harlequin bug continued to attack cole crops in some southern districts, including Virginia, South Carolina, Georgia, Florida, Mississippi, and Louisiana. Cutworms, in some instances in association with armyworms, were reported causing from some to severe damage to cole crops in South Carolina and Florida during the latter part of October.

A severe outbreak of the Hawaiian beet webworm on spinach was reported in the Norfolk district of Virginia toward the end of October. Harvest was delayed in some fields because of the damage which ranged from heavy in some fields to moderate and light in others. Extensive use of insecticides brought the outbreak under control early in November. This insect was also observed causing severe injury to a small planting of beets in the Charleston district of South Carolina in early November.

The tomato fruitworm was reported the last week of October causing serious damage to tomatoes in Dade County, Florida, and some damage in Mississippi. It continued to damage tomatoes in Orange County, California, into early November, but the infestation was low.

The melonworm or the pickleworm persisted as pests of cucurbits in many areas throughout the period. Moderate to heavy infestations were reported from Virginia, South Carolina and Florida, and some injury to late squash was reported from Maryland and Georgia.

Light infestations of the beet armyworm and the lettuce looper were present on lettuce in the Salt River Valley of Arizona during the last half of October. Some dusting, chiefly with DDT, was applied to late plantings largely as a precautionary measure. Infestations of the beet armyworm caused some injury to young peas in southern California in late October and most fields required treatment. Good control with DDT dust was reported.

The Mexican bean beetle continued to decline in abundance in accordance with seasonal effects and by the end of October this pest had become of only slight economic importance even in the southernmost districts. Adults were reported going into hibernation in Florida and South Carolina the first week of November. Because of the heavy fall populations and absence of early frosts to check the development of both insect and host, the beetle is expected to hibernate in large numbers in those areas. The number of adults entering hibernation in eastern Virginia has been reported as greater than for a number of years. An isolated infestation in Union County, Florida, made a strong development this year and heavy damage occurred to fall bean plantings in that area.

Moderate to light infestations of the bean leaf roller have been reported from South Carolina, Georgia, Florida, and Alabama during the period. The bean leaf beetle was still present in small numbers on beans in South Carolina shortly after mid-October.

The southern green stinkbug persisted in moderate to light infestations on beans in South Carolina, Georgia and Florida throughout most of the period. The potato leafhopper continued fairly abundant on beans in parts of Florida during the last half of October.

Light to moderate numbers of aphids continued to occur on cole crops in practically all of the southern states reporting. In southern California the cabbage aphid infestation had gradually built up to the

(*Turn to Page* 64)

The 1946 Epiphytotic of Tomato Late Blight

This department, which reviews current plant disease and insect control problems, is a monthly feature of AGRICULTURAL CHEMICALS. The following comments on current plant disease problems are based on observations submitted by collaborators of the Plant Disease Survey. The following summary of their most recent reports was prepared especially for this magazine.

By Paul R. Miller

IN ORDER to present as complete a record as possible on the final outcome of the threatening tomato late blight outbreak reported under this heading in the September issue of AGRICULTURAL CHEMICALS the Survey asked its collaborators to summarize their information on certain phases of its development in their States. (*Turn the Page*)

A questionnaire on certain specific topics was included in the request for information. The questions are listed and a brief resume of the replies is given.

1. *Can you supply estimates of loss from your State?*

Replies came as follows:

Table 1.

Losses From Late Blight on Tomato:

Alabama

75% early crop (800 acres in Southeast)

25% on late crop (8000 acres in Northeast and Central)

Florida

40% Homestead area

50% Palm Beach, Martin, Broward County area

Georgia

Early green wrap fields 60-70%; in late planted about 40%

South Carolina

From 10 to 65% in principal tomato producing counties, average 55%

North Carolina

In Eastern, 5% early, 25% late crop

Western, 90%, in home garden and commercial

Virginia

Green wraps 75%; canning 50%

In Norfolk—Eastern Shore area green wraps 75%; canning crop negligible

West Virginia

40-50%

Maryland

40% of potential crop

Pennsylvania

60% average, range 5-95%; severe on young plants and mature crops

Delaware

50% of potential yield, ¾ of this loss on late, ¼ on early and midseason tomatoes

New Jersey

20-30% potential crop in South; 30-40% in Central; 50-60% in North. Largest acreage in Southern half

New York

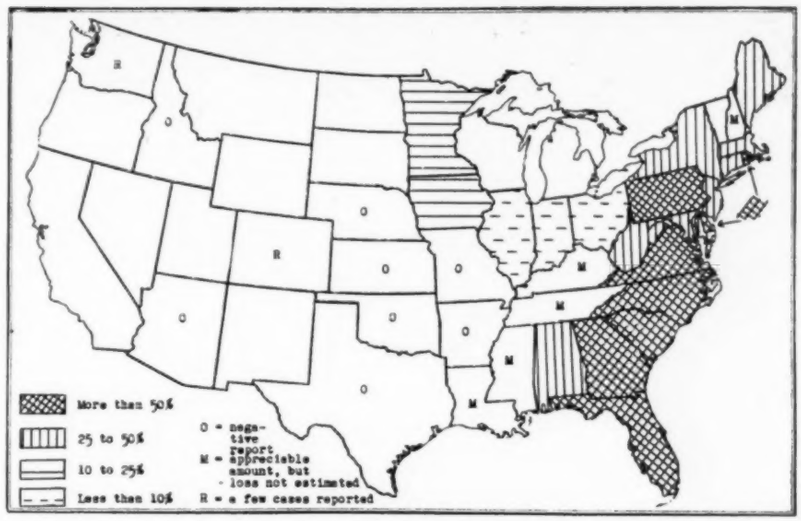
Possibly 25%

Connecticut

25%

Rhode Island

70-90%


More than 50%
25 to 50%
10 to 25%
Less than 10%
O = negative report
M = appreciable amount, but loss not estimated
R = a few cases reported

Loss from tomato late blight in 1946.

Massachusetts

50% commercial; 75% home garden

Maine

25-35%

Ohio

8%, 3% fruit loss, 5% from plant stand, 3% loss canning area, 20-25% staked tomato area. About 50% of fields reset to some degree

Indiana

Perhaps 10%, including early stand losses and subsequent foliage and fruit destruction

Illinois

Less than 1% for State (5% in one tomato area, 7% in another)

Minnesota

10-20%

Iowa

15%

2. *Was the loss on young plants or did it occur on the mature crop?*

In general, major damage was to maturing plants, from yield reduction and fruit infection. However, in

Table 2.

Fungicides used for spraying or dusting for control of tomato late blight, 1946[1]

Spraying materials used	*State*	*Dusting materials used*	*State*
"Dithane"+zinc-lime	Florida Delaware	Fixed copper	Maryland Pennsylvania West Virginia Ohio Illinois North Carolina South Carolina
Fixed copper	Maryland Pennsylvania North Carolina		
Neutral copper	Delaware Massachusetts	Neutral copper	Delaware Massachusetts Maine
Metallic copper	Ohio		
"Dithane" Reaction Product (He 178e)	Delaware	Bordeaux	Massachusetts
"Dithane"	Connecticut Massachusetts	Copper-lime	West Virginia
"Phygon"	Connecticut	Copper	Virginia Indiana
Bordeaux	Connecticut Massachusetts West Virginia Maine Ohio Virginia Pennsylvania	Insoluble copper	New York

[1] In this tables the terms "fixed copper," "neutral copper," and "insoluble copper" are given as reported by the various collaborators, although these names are actually synonymous and refer to materials of the same type.

many States infection of young plants, whether imported or home-grown, was severe and caused a considerable amount of replanting and some abandonment.

3. *What control measures were taken?*

Table 2 lists the materials used in the various States.

"Fermate" or "Zerlate" and Bordeaux in staggered program — New York

4. *Which gave better results, spraying or dusting?*

In most of the answers commenting on this subject spraying is reported as more effective. Generally, however, lack of equipment and late beginning, rather than type of application, were responsible for poor control.

5. *If dusting was done by airplane was it effective?*

See Table 3. As with other methods of application, late starting was partly responsible for mediocre results.

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TALC

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SOFT flaky particles which enhance stickiness.

COMPATIBILITY with all insecticides.

SOFTNESS which eliminates abrasion in dusting machine nozzles.

FINENESS — The proper fineness for complete coverage, determined by Entomologists.

UNIFORMITY of all qualities guaranteed by the largest manufacturer of the greatest variety of talcs in the world.

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•

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Burlington **Waterbury** **Johnson**

VERMONT

Table 3.

Use of airplane dusting for tomato late blight control is listed below. Results are recorded under each state name:

Georgia

Less effective than tractor dusting

South Carolina

In one case no basis for comparison; in another, both plane and power dusting moderately successful

Virginia

Not very effective

Maryland

Most dust applied with airplanes; results disappointing. One case spraying by airplane a failure

Pennsylvania

Checked disease but less effective than ground spraying

Delaware

Last choice of methods

New Jersey

Last choice

New York

Airplane dusting effective where used —started early

Ohio

Partially effective

Indiana

Dry weather confused results

Illinois

Believed effective

6. *About what percentage of the growers in your State attempted control measures?*

Louisiana, Mississippi, Alabama, Connecticut, Rhode Island, Wisconsin, and Minnesota reported from "none" to "very little if any," in answer to this question. Other replies indicated slightly greater interest in control. Georgia reported "100% plant growers, probably less than 1% green wrap." Replies from South Carolina, North Carolina, Virginia, West Virginia, Maryland, Pennsylvania, Delaware, New Jersey, New York, Massachusetts, New Hampshire, Maine, Ohio and Illinois reported up to 50% in some areas.

7. *Are you preparing expanded control facilities for possible use next year?*

For the most part the answer is "Yes," at least to the extent of watching for threatening infections and warning growers in time to take measures. ★★

Comments....

By Dr. Alvin J. Cox

This column by Dr. Cox will appear from time to time as a feature of AGRICULTURAL CHEMICALS. Dr. Cox formerly was successively Physical Chemist, Chief Chemist, Assistant Director, and Director of the Bureau of Science, Government of the Philippines. He was appointed Chief of the Bureau of Chemistry, California State Dept. of Agriculture in 1932 and retired in 1945.

THE agricultural chemical industry is seeing a trend toward protective labeling on its products, in an effort to give careful directions for the use and application of economic poisons. In the interest of its own well-being, the industry should see that misrepresentation in advertising and inadequate information on labels be corrected. Indeed, manufacturers should be constantly on the alert for possibility of unforeseen hazards which may come to light in various applications, and field men and farmers should be encouraged to report such hazards to manufacturers.

Instances of misleading, if not downright untrue labeling come up from time to time, many of which could easily bring legal difficulties to the manufacturer if allowed to reach the public. Among the many cases coming under my jurisdiction as Chief, Bureau of Chemistry, California Department of Agriculture, was that of a manufacturer who wished to register a product which was without value for the purpose indicated, but was labeled "Double Strength." The explanation was that the product was double the strength it formerly was.

In another case, the solid ingredients of a spray applied by airplane were known to detonate when dry, but there was no warning to that effect on the label. The results would have been disastrous, of course. Upon my request there was added to the label a special caution to wash off all of the residual product from equipment and containers.

In still another case the seller was relieved of responsibility for damage done by his product because his label contained a caution against application of the product when warm weather might be anticipated. Despite the warning on the label, a user applied the product even though the weather bureau had predicted a hot wind in advance of use. Damage resulted, and in a subsequent suit the court decided that in view of the label's wording, the user alone was responsible.

If sufficiently poisonous, an economic poison is required to carry upon the label the word "Poison" and the vignette representing the skull and crossbones, printed in red on white background or the reverse, and also to carry the official antidote. The labels of some corrosive poisons are required to bear external as well as an internal antidote. Dilution of a product to the point where the poison insignia is not required does not permit an economic poison to be designated as nonpoisonous, safe, or harmless. If the diluted product is still effective against a pest it may be potentially injurious to human beings, and designations such as "nonpoisonous" may encourage carelessness in handling a material. Some nerve depressant and other insecticides are either primary skin irritants or sensitizers, some are both, and several cases of dermatitis resulting from their use as economic poisons have been reported. In one case wherein a new intensifier was insufficiently investigated as to its pharmacological effect, dermatitis was reported so often and unmistakably that enforcement measures were undertaken resulting in its withdrawal from sale. Anything that may poison insects may be injurious to man, and statements that go too far in minimizing the danger tend to make users negligent and careless in handling these products.

Some manufacturers still try to put everything into one product to kill all pests at once. It is unlikely that this can ever be accomplished, and it would probably be undesirable if it were possible. The products that are selective against a given pest in general have been the most satisfactory in the long run.

The rapid increase in the number and use of synthetic organic chemicals illustrates the need for study to provide data for intelligent handling of products of this nature. Possible industrial health hazards of new products should be anticipated. Problems constantly arise as to hazards to workers not only in mixing of chemicals but in making field applications. When a chemical is not acutely poisonous, generally little is known as to the extent of its injuriousness. Information should be at hand with regard to insidious chronic poisoning by newly developed materials, as well as to their acute toxicity. Certain manufacturing and pest control operations involve inhalation of dusts of unknown toxicity, and employees should be instructed with regard to the use of

(*Turn to Page* 64)

KAOLIN CLAYS

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For use in extending DDT and other insecticidal materials

APPROVED by entomologists, these clays have also met with general acceptance by mixers and blenders of agricultural insecticides.

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- SMALL PARTICLE SIZE
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2,4 Dichlorophenoxyacetic Acid

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DDT

Dichlorodiphenyltrichlorethane

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Suppliers' Bulletins

Westvaco Bulletin

Westvaco Chlorine Products Corporation, New York, has issued an eight-page technical bulletin covering Hydrogen Bromide Anhydrous and Hydrobromic Acid 48% Aqueous. The bulletin gives properties, composition range, analyses and uses as well as citing many reactions of these products. Particular reference is made to the indicated applicability of Hydrogen Bromide Anhydrous as a catalyst, bromination, esterification, condensation, alkylation, isomerization, oxidation and addition compound. Copies are available at 405 Lexington Ave., New York 17.

•

Sprout-Waldron Bulletin

A new bulletin illustrating and describing its "Pneu-Vac System" of handling all types of free-flowing materials, has been issued by Sprout-Waldron & Co., Muncy, Pennsylvania. The company also announces another bulletin describing its new rotary knife cutter, designed for heavy duty and large capacity. Both bulletins, No. PV 546 and HDC-446, respectively, are available from the Sprout-Waldron Company.

•

Carbide, Carbon Book Out

Carbide and Carbon Chemicals Corp., unit of Union Carbide and Carbon Corporation, New York, has issued a new 72 page edition of its book, "Emulsions." The new issue features extensive additions and revisions to the material presented in previous editions.

Uses of soluble oils in orchard sprays are described in one chapter devoted to the subject. It explains the processes through which oils are used for control of various insect pests, and the functions of the oil either as stable or unstable emulsions. Basic facts of how oils are used in connection with sprays of lead arsenate are recounted, with instruction regarding the mixture considered best for spraying purposes.

Other chapters of the book treat such topics as amine soaps and cationic dispersants, as well as description of the uses of "Tergitol" wetting agents, "Carbowax" polyethylene glycol emollients, and "Cellosize" hydroxyethyl cellulose thickener in new emulsion formulas. The book may be had from any district sales office or from the home office of Carbide and Carbon Chemicals Corp., 30 East 42nd St., New York 17.

•

Hexa-Tetra Offered

California Spray - Chemical Corp., Richmond, Calif., has issued a bulletin on "Vapotone" insect spray which it announces is now available to the trade. The new product is hexaethyl tetraphosphate, which California Spray-Chemical is among the first to place on the market.

The bulletin gives instructions of use, proper proportions of mixing, and when and where to use it. Hexaethyl tetraphosphate has proved particularly effective against red spider and aphids as well as other insect pests. The company invites further questions regarding the product.

•

Pennsalt Bulletins

Pennsylvania Salt Co., Philadelphia, has revised its leaflets on B-K sanitation and B-K bacteria control for diary equipment, and offers them to the trade. The six-page color leaflet on bacteria control for dairy equipment gives instructions on milk and dairy sanitation from cow to consumer's table, and tells how the B-K powder plays a part in this process. Copies of these leaflets are available from the company offices, 1000 Widener Bldg., Philadelphia 7.

•

"Toxaphene" Announced

Hercules Powder Co., Wilmington, announces a new insecticide toxicant, "Toxaphene," which preliminary tests indicate to be as effective as DDT against certain insects and more effective against others. The new product is a chlorinated camphene, and has been undergoing tests for the past 18 months in more than 75 different locations in the U. S. under the name "Hercules Synthetic 3956."

These tests indicate it to be effective against cotton insects, tobacco horn worm, Mexican bean beetle, flies, clothes moths, and roaches.

Geigy Company, Inc., New York, announces the availability of eight new booklets describing methods of using insecticides for best results. Shown above, the booklets cover control of pests attacking forest and shade trees, field crops, livestock, potatoes, truck crops, flowers, shrubs, lawns, dairy cattle (barn fly control), and fruit trees. Write Geigy Co., Inc., 89 Barclay St., New York 8.

H. D. Hudson Manufacturing Company, Chicago, is one of the first of American sprayer manufacturers to announce unrestricted sales and supplies of any models since before the war. The firm has issued a folder on its "Admiral" duster for garden, field and household use, emphasizng the fact that the product is available in quantity.

The "Admiral" itself is a hand-operated duster which features a large capacity for holding dust, a long tube with adjustable nozzle, making less difficult dusting in awkward places. Other features include a simple refilling procedure and an easy stroke. More than 3 million similar dusters were manufactured by Hudson for use by the U. S. Armed Forces during the war.

Above is seen the Hudson "Admiral" in use dusting a home flower garden, and treating cabbage plants in a larger plot.

Eastern A.A.E.E. Meets

The 18th annual meeting of the Eastern Branch of the American Association of Economic Entomologists was held at the Lord Baltimore Hotel, Baltimore, Md., November 21 and 22. The program included thirty-two papers, including a number on DDT, several dealing with experimental results on benzene hexachloride, one dealing with a new insecticidal material, a chlorinated bicyclic terpene (No. 3956) against certain fruit and vegetable insects, and a series of papers on aerosols. At the aerosol session on the afternoon of November 22nd, brief unscheduled talks were given by Frank K. Steinrock of Todd Shipyards Corp., New York, and by Hession Microsol Corp., Dairen, Conn. John W. Hession explained the design and operation of a new device which his company is making for the mechanical production of aerosol sprays. Three models will be made when the device gets into commercial production, a small household model, an industrial model and a field model, the first two electrically operated and the field model powered by a gasoline motor. The device produces an aerosol spray by centrifugal action, without use of a propellent or generation of heat. Particle sizes as low as 10 microns can be produced.

Papers and authors appearing at the meeting included the following: "Host plants of bugs that cause cat-facing of peaches in Virginia", by A. M. Woodside, Staunton, Va.; and "Recent advances in control of shade tree insects", by Stanley W. Bromley, Stamford, Connecticut.

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5. BLACK LEAF 10 DUST BASE—meets the demand for a non-alkaline neutral dust.

6. BLACK LEAF CUNIC DRENCH—for sheep and goats. Formula recommended by U. S. Dept. of Agriculture.

7. BLACK LEAF DRY CONCENTRATE—used either as a spray or base mixture with carrier for dusting.

THE "TOBACCO BY-PRODUCTS" LINE ALSO INCLUDES

8. MASH-NIC — for mixing with poultry feed to control large roundworm.

9. NICO-FUME LIQUID—for greenhouse work.

10. NICO-FUME PRESSURE FUMIGATOR—spreads fumes under pressure when ignited. Saves contact of hands with powder.

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Raw Material Markets . .

SUPPLIES for next year's insecticide needs appear to be in a precarious state from this point, with the burden of a national coal strike added to the already long list of troublesome factors in certain categories. The new insecticide year began on October 1 with stocks at a record low level, and a shortage of shipping facilities and containers, as well as of some raw materials. "Order Early" is the industry's plea.

In the fertilizer field increased activity was noted beginning in October when some of the small mixing plants reopened to prepare for the heavy consuming season ahead. Increased export quotas from Argentina brightened somewhat the outlook for the importation of organics.

Insecticides

Although production of DDT during the early fall was up, this factor does not put the material in the "plentiful" class by any means. An acute shortage of chlorine which is further aggravated by the coal strike, has slowed down DDT output greatly, so compared to that "ordered-ahead", the supply falls short of meeting the demand. However, figures for August, (latest available) show an output of 4,080,000 pounds, which was 7 per cent better than the previous month.

Pyrethrum

In direct contrast to DDT, supplies of pyrethrum offer no problem to consumers. Present stocks are ample, and it is anticipated that the demand for this insecticide in 1947 will be more than met. August imports were less than half the amount received in July. The 739,000 pounds received in August included 13,000 pounds from Chile . . . the first time this year that pyrethrum has arrived from that source. U. S. exports totaled 8,000 pounds in August.

Rotenone

The Peruvian market has been thrown open to speculative offers both from the United States and abroad, some at very high prices, since the removal of price ceilings on November 10. Under the agreement of May 7, 1946, made with the suppliers in Peru for the duration of one year, supplies came to the U. S. satisfactorily, but competitive price bidding which came after November 10 halted shipments. The trade concedes three facts: (1) There will be no more material available from South America at the old price. (2) Until merchants and producers in South America have taken bids to find the maximum price for their roots, no substantial shipments are probable. (3) Prices may be forced to such a level that legitimate processors and consumers may find rates out of reasonable reach. U. S. supplies for 1947 may thus constitute only the amount of rotenone now in the hands of the trade . . . which, fortunately, is of fair proportions.

Copper Sulfate

Compared to last year's purchases of copper sulfate for agricultural use, buying for the 1947 season shows considerable improvement. Export demands are increasing. In August, 13,145,000 pounds were exported, to mark the high point of the year since February.

The Arsenicals

Bottleneck of lead arsenate has been the lack of lead, but low seasonal demands for lead arsenate makes present supplies adequate. For the remainder of the year, lead for the manufacture of insecticides may be obtained only on written authorization by the Civilian Production Administration. Total allotments for this purpose during the period between October 18 and the end of the year were 10,000,000 pounds of lead, enough to produce 16,500,000 pounds of lead arsenate. If this production is reached, it would exceed by 30 per cent the output of the same period of 1945.

The calcium arsenate situation is expected to remain fairly easy at least until orders for next season come in. Against the lowest carry-over on record, the production figures are encouraging. August output was 8,081,000 pounds which was 26 per cent above that of July, and more than 3½ times the output of August last year.

Adequate stocks of white arsenic are not yet in view, although the general outlook is better. Output of copper determines to a large extent the amount of arsenic to be available, since supplies from places other than the United States and Mexico are uncertain. August imports of white arsenic totaled 2,648,000 pounds, which was 23 per cent more than July's receipts and the highest of any month since May. The large bulk of August's imports came from Mexico, the remainder from Canada and Sweden.

The outlook for 1947 on nicotine supplies remains uncertain, a condition accentuated by the fact that there was practically no carry-over into the new insecticide year. At the same time, exports of nicotine sulfate in August, 16,000 pounds, were high for any month this year except March when 33,600 pounds were shipped out. Canada, Yugoslavia, Norway and The Netherlands were the principal destinations of August's shipments.

Fertilizers

Based on the supposition that the Government would return in time the 22,000 tons of nitrogen "borrowed" from domestic supplies for shipment abroad, early November market reports indicated that the supply of nitrogen might not miss by far the estimated requirements of 800,000 tons. However, since then the news has come that the War Department will be unable to return the borrowed materials*, which is disrupting the industry's plans for the new year. Little over-all increase in nitrogen is foreseen for the current fertilizer year. Further expansion in production of ammonium nitrate and nitrogen solutions will probably be just about balanced by a smaller output of ammonium sulfate, a decrease in imports, and larger exports.

* Full story of fertilizer situation elsewhere in this issue.

Sell a Package of INSECT DEATH

The directions for proper use of your product may say "spray" or "dust." You want that spraying or dusting to be *well done* so that your product will be most effective. That's where Lowell Sprayers and Dusters come in.

SELL A PACKAGE OF INSECT DEATH

The Lowell line is complete. There is a sprayer or duster for every need. Why be "insecticide-wise and sprayer-foolish" when you can get Lowell quality? Combine Lowell Sprayers and Dusters with your product to make a fast-selling package of insect death. Write us!

LOWELL
Manufacturing Co.

Dept. 59, 589 East Illinois Street, Chicago II, Illinois

WORLD'S LARGEST MANUFACTURER OF SPRAYERS AND DUSTERS EXCLUSIVELY

To Our PYRAX Customers

We have expanded our plant and are now producing more PYRAX ABB than ever before.

But we still cannot make enough to fill all of your orders in any one season.

To avoid disappointment and to insure satisfying your 1947 requirements, we urge you to schedule your needs well in advance, to order early and to take delivery of at least part of your order during the Winter season.

We will appreciate your cooperation.

R. T. VANDERBILT CO., Inc.
Specialties Dept.
230 Park Avenue · New York 17, N. Y.

OPPORTUNITY KNOCKS

Each month in this magazine's

Classified Section

Whether you are a buyer or seller, seeking a position or searching for the right man for a job, you are very likely to contact the correct person or firm in the field of

AGRICULTURAL CHEMICALS

254 W. 31st St. New York 1, N. Y.

Industry Patents

The following patents have recently been issued by the U. S. Patent Office on products and devices in the agricultural chemical field. Copies of the patents may be obtained at 25c each by addressing the U. S. Patent Office, Washington 25, D. C.

2,409,621. METHOD OF CLOSING BAG TUBE ENDS. Patent granted Oct. 22, 1946, to Wm. J. Geimer and Frank R. Linda, Minneapolis, Minn., assignors to Bemis Bro. Bag Co., Minneapolis. The method of closing and sealing the open top of a bag of the intucked type, which consists in securing anchor elements to certain wall positions at the sides of the bag top, which anchor elements have ends projecting above the upper edges of the bag top walls, intucking the edge walls of the bag top between the side walls thereof, pressing all of said walls into flatwise relation, bending the projecting ends of said anchor elements over and against certain of the bag top walls, and folding a strip of tape over the flattened end of the bag top and adhering it to the outer surfaces of opposed walls, thereby to seal the bag top.

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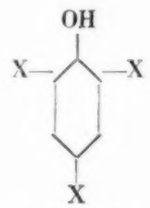
2,409,626. BAG OPENING AND FILLING APPARATUS. Patent granted Oct. 22, 1946, to M. J. Harrington, Cleveland, Ohio, and Samuel E. Hammer, Eagleville, Pa. An apparatus with a pair of adjacent substantially coextending generally flat members adapted to be inserted into a bag by relative telescopic movement between said members and bag, and means for imparting substantially parallel movement to one of said members to cause opening of the bag by spreading the walls thereof, one of said members having an opening therein adjacent its lower end and the lower end of said other member being curved toward said one member and adapted to extend into said opening when said members are in their bag-receiving position.

2,410,281. PARASITICIDAL COMPOSITIONS. Patent issued Oct. 29, 1946, to Fred W. Fletcher and Eugene E. Kenaga, Midland, Mich., assignors to the Dow Chemical Co., Midland, Mich. An ovicidal composition for application to living trees including a dormant spray oil and as an active toxicant a compound having the formula



wherein X represents a nitro radical, another X represents chlorine, and the third X is selected from the group consisting of chlorine, alkyl, cyclohexyl, and hydrogen.

Trade Mark Applications

MICE DOOM, in upper and lower case letters, for poison for animals such as mice. Filed Oct. 11, 1945 by Edgar A. Murray Co., Detroit. Claims use since 1898.

RAT DOOM, in capital letters, for poison for animals such as rats. Filed Oct. 11, 1945 by Edgar A. Murray Co., Detroit. Claims use since 1898.

BOW-AND-ARROW MOTIF, for Insecticides and insect sprays of the residual and contact types. Filed Apr. 11, 1946, by Dorsett-Jones, Inc., Baltimore, Md. Claims use since Feb. 27, 1946.

SOIL-TEX, in very heavy capital letters beneath a target-like shield of five concentric circles with the word "Orfac" in the center. For mixture of sheep manure and peat moss for treating soil. Filed Feb. 6, 1946, by Organic Factor and Chemical Co., also doing business as Organ Factors and Chemicals, South San Francisco, Calif. Claims use since May, 1946.

GENITOX, in capital letters, for insecticides. Filed Apr. 11, 1946, by General Chemical Co., New York. Claims use since Mar. 4, 1946.

PIED-PIPER, for product in powdered form for use in the extermination of rats and mice. Filed Nov. 15, 1945 by the De Pree Co., Holland, Michigan. Claims use since Mar. 1, 1945.

KACECO FUME-O-DEATH INSECTICIDE, in capital letters with line drawing of insect imposed within the letters. For insecticides. Filed Dec. 3, 1945, by Knox Chemical Co., Chicago. Claims use since Sept. 15, 1944.

GERM-O-TONE, in small capital letters with drawings of animals above letters. For medicinal compound for the prevention against and removal of intestinal worms from poultry, livestock and dogs; and aid against lice, mites, bluebugs and fleas on poultry and livestock; aid in the prevention of diarrheas, coccidiosis and other intestinal troubles in poultry and livestock, etc. Filed Jan. 17, 1946, by Dean Milton Schlarbaum, doing business as A-1 Remedy Company, Albuquerque, N. Mex. Claims use since Jan. 1, 1940.

DIXO, in large capital letters for insecticide, disinfectant and deodorant. Filed Mar. 18, 1946 by George S. Brehm, doing business as Hygienic Sanitation Co., Philadelphia. Claims use since July 1, 1923.

STEROX, in black Cooper capital letters. For Herbicides. Filed Mar. 18, 1946 by California Spray-Chemical Corp., Richmond, Calif. Claims use since Feb. 25, 1946.

RESIDOL, in stencil-type capital letters, for insecticide. Filed Apr. 15, 1946, by Shell Oil Co., Inc., San Francisco. Claims use since Mar. 8, 1946.

Trade Marks Granted

424,699. CHEMICAL PREPARATION CONTAINING CALCIUM CYANAMIDE USED TO REMOVE FOLIAGE FROM PLANTS. Filed October 12, 1944, by American Cyanamid Co., New York.

424,736. INSECTICIDES. Filed Dec. 8, 1945, by Amos R. Beamon, doing business as Teknol Products Co., Los Angeles, Calif.

424,740. STOCK POWDERS USED FOR HORSES, CATTLE AND HOGS TO RELIEVE CONSTIPATION AND EXCESS ACID, REMOVE WORMS, AND PURIFY THE BLOOD. Filed Dec. 22, 1945, by Joel E. Lankford, Suffolk, Va.

1946 by Anna Edin, doing business as Edin & Co., Minneapolis, Minn.

424,793. POWDERS FOR KILLING FLEAS, LICE AND TICKS; POISONS FOR KILLING RODENTS, INSECTICIDES, AND A COMBINED INSECTICIDE AND SULFUR DUST. Filed Mar. 13, 1946 by J. A. Stanley, doing business as Stanley Industries, Seattle, Wash.

425,119. INSECTICIDE OR INSECT EXTERMINATOR. Filed Oct. 11, 1945, by Edgar A. Murray Co., Detroit.

425,120. Same as 425,119.

425,130. FUNGUS INHIBITING AND IMPREGNATING CHEMICALS. Filed Nov. 21, 1945, by Paint Engineers, Inc., New York.

425,134. INSECTICIDES AND FUNGICIDES. Filed Nov. 28, 1945, by Sherwin-Williams Co., Cleveland, Ohio.

425,139. INSECTICIDES. Filed Aug. 6, 1946 by Northeastern Products, Inc., Boston.

425,161. INSECTICIDES. Filed Jan. 29, 1946 by Fred L. Smith, Paola, Kansas.

425,179. ANTHELMINTIC TABLETS. Filed Mar. 6, 1946 by Allied Laboratories, Inc., doing business as Pitman-Moore Co., Indianapolis, Ind.

425,184. RAT BAITS. Filed Mar. 11, 1946 by Cenol Co., Inc., Chicago.

GUEST EDITORIAL

(*Continued from Page* 14)

learned the terms of soil classification and have come to understand the practical significance in cultivation and tillage of the component mechanical fractions.

As an industry, agriculture is concerned with the utilization of a larger number of chemical elements than any other with which it might logically be compared.

Thorough-going farmers acquire quite early in their crop-producing experience through observation alone rather complete information on chemical shortcomings of the soil series and types it is their lot to own and cultivate. If sufficiently well-read and experienced, they may be able to tell offhand what particular chemical element or elements are required to spark or perhaps rejuvenate any that may not be producing up to capacity. In all probability the economics of the situation will in the end determine the farmer's course.

Nothing is more fundamental or widely known among farmers than the fact that crop growth is made at the expense of soil-farming minerals and closely intermingled organic matter. Together the minerals on weathering yield the more readily soluble salts of the chemical elements; viz., the sulfates, phosphates, nitrates, and chlorides of calcium, magnesium, sodium, potassium, manganese, and iron. Soils are potentially highly fertile or less so in keeping with the liberality of their endowment with the soil-forming minerals intermingled with such organic matter as is capable of yielding the inorganic compounds of nitrogen by weathering processes and bacterial action.

Soils are rich, poor, or intermediate in quality in keeping with their capability of supplying growing crops with liberal amounts of all chemical elements essential to growth. In our land there are extensive areas here and there noted throughout the nation for their inherent richness in all essential mineral elements and nitrogen. Within the borders of our land, too, there are extensive areas of notably poor lands as measured by unaided crop production standards. Owners cannot hope to use them profitably without artificial mineral fertilization and some practical means of creating a reasonable surplus of active organic matter. Intermediate are great areas known to be farmed in large part without supplemental fertilization.

The American fertilizer industry has remarkable resources from which to assemble the raw materials from which fertilizers are compounded. Potassium salts of highest purity are obtained from the remnants of desert lake waters. Phosphate-containing minerals originate in mountainous areas both east and west. Sulfur is available from vast deposits of that element far below the surface of the low ground areas of Louisiana. Lime, the most common of the fertilizers, if we wish to call it such, is available from mountainous areas of limestone rock. And, finally, nitrogen is obtainable in inexhaustible amounts through the medium of nitrogen-fixation plants—the source being the atmosphere. No farming area need be without the means of rejuvenating its rundown lands for lack of suitable fertilizing material. The Fertilizer Industry is a highly essential factor in American agriculture.★★

COX COMMENTS

(*Continued from Page* 57)

masks for protection. Where the hazard is not definitely known, the cautioning of workmen is frequently neglected. All information with regard to new agricultural chemicals should be pooled, and then in a conference of manufacturers, officials and other interested parties a proper and worthwhile label can be developed.

Everyone in the agricultural chemicals industry should work for the common interest. Each can make the work of the other (manufacturer, official, user) easier by knowing more about the people with whom he is dealing. For real progress there must be bridges of understanding and respect for differences of opinion rather than building up road-blocks of prejudice. In other words seek the means for complete cooperation by all.★★

LISTENING POST

(*Continued from Page* 54)

point where serious loss was anticipated after the middle of October. Due to lack of sufficient nicotine to treat the large acreage of cauliflower infested with aphids, a number of growers were reported to have used hexaethyl tetraphosphate and apparently obtained excellent results. In early November some 400 acres of broccoli in northern Kern County were reported quite free from aphids. At the same time, a severe infestation of aphids was reported from most of the fields comprising about 350 acres of cauliflower east of Bakersfield.

Classified Advertising

Rates for classified advertisements are ten cents per word, $2.00 minimum, except those of individuals seeking employment, where the rate is five cents per word, $1.00 minimum. Address all replies to Classified Advertisements with Box Number, care of Agricultural Chemicals, 254 W. 31st St., New York 1. Closing date: 1st of month.

Wanted: Regional Sales Supervisor for Agricultural Chemicals. —National Corporation would like to secure the services of an agricultural chemist on the Pacific Coast and Southwestern area of the United States. At least ten years of sales experience in this field is required. Excellent opportunity to handle a large volume of potential business. Give full details as to background, experience and salary requirements. Address Box 131, care of *Agricultural Chemicals.*

Wanted: Five (5) Regional Technical Sales Assistants. National Corporation needs five agricultural school graduates familiar in the use of insecticides and fungicides. State educational background and practical field experience, region of country preferred and starting salary required. Address Box 132, care of *Agricultural Chemicals.*

Chemist—Wanted by insecticide manufacturer, young chemist with some experience in chemical and botanical insecticide materials. Extremely good future opportunity for energetic graduate chemist. Give details, salary, etc. Address Box 134, care of *Agricultural Chemicals.*

DDT For Sale—Ready to mix 25% DDT in water miscible concentrate, approved formula, standard product. Packed in 55 gallon drums. All ready to dilute and use. Priced lower at $1.78 per gallon. For details, write to Box 135, care of *Agricultural Chemicals.*

Insecticide Research—Man with experience in truck crop insecticide research for large oil company; also on live stock pest control, desires position in this field. College graduate. For further details, communicate with Box 136, care of *Agricultural Chemicals.*

Rodent Control—Biologist with experience in rodent and insect control desires position with manufacturer in sales and technical service. Recently out of service, 30 years of age, graduate in biology from Texas A. & M. Prefer eastern location. Address Box 133, care of *Agricultural Chemicals.*

DDT—Notice Exporters —DDT

Offer subject to prior sale, approximately 2,000 gallons of 35% Water Miscible DDT Xylene Base, manufactured by Hercules Powder Co., packed in the original 55 gallon drums. Priced reasonably. Address Box 137, care of *Agricultural Chemicals.*

INSECTICIDE CONSULTANTS

Are you selling potato growers a spray or dust program that will benefit them and make you some money?

We are experienced in commercial potato spraying and dusting from Colorado to the Atlantic.

AMHERST CHEMICALS, INC.
Dean Asquith, President
18 Nutting Ave. Amherst, Mass.

ALVIN J. COX, Ph.D.
Chemical Engineer and Chemist
(Formerly Director of Science, Government of the Philippine Islands; Retired Chief, Bureau of Chemistry, State of California, Department of Agriculture.)
ADVISOR ON AGRICULTURAL CHEMICAL PROBLEMS AND INVESTIGATIONS
Consultant in reference to spray injury and damage, claims, including imports of fruits and nuts, formulas, labeling, advertising and compliance with law.
1118 EMERSON STREET
PALO ALTO, CALIFORNIA

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"Ah guesses dat ah ain't perzakly fitted fer dis yere job, Cuthbert!"

Wrong Fit?

IS your advertising fitted for the job you want it to do? And do the media which carry your message fit perfectly into the picture to bring what you have to say directly to the people you wish to impress? Advertising must go bullet-like, straight to the target. It should not be allowed to dissipate its energy through general media where but a small part of the readership is interested in your sales story.

If you have an advertising job to do in the field of insecticides, fungicides, fumigants, fertilizers, or equipment for applying chemicals for agriculture, you can cover the field completely at low cost, without waste, through

AGRICULTURAL CHEMICALS

254 WEST 31st STREET NEW YORK 1

TALE ENDS

AGRICULTURE-CONSCIOUS Texas is the scene of competition for numerous awards to be made in 1947 for high attainment in a "save the soil" campaign. The movement, begun this year in Fort Worth, has now spread throughout the state, and 1947 will see the program carried on through the state's 130 organized soil conservation districts. The prize list includes $10,000 in cash, 135 plaques, certificates and other recognitions.

•

Of scientific interest to the trade is an announcement by Montana State College of development of a thermacouple, electrical device for measuring the temperature of grasshoppers. The delicate instrument is 5/1,000ths of an inch in diameter, and can be used without injury to the insect. Practical aspect of the instrument is that it contributes to a study of when and where the grasshoppers eat and where poison bait should be placed. Temperature of the air, sunlight intensity, and the insect's body temperature are all thought to be related to the pest's eating habits.

•

If anyone feels that men who engage in the business of killing insects and other pests are hard hearted, let him consider the case of F. G. Fahrbach of Pelham Manor, N. Y. who recently resigned from a position of constable to return to his business as an exterminator. The reason for the change was reportedly Mr. Fahrbach's reluctance to act in the role of evicting families during the current housing shortage. The last straw seems to have been regarding eviction of a widow and her two children who had no other place to live.

•

A recently organized New York advertising agency, Day, Duke & Tarleton, is providing the trade with material for new gags, according to "Tide" magazine. Mainly because the firm is known by its initials. No doubt it will be very tough with "fly by night" accounts.

OX-WARBLE FLY

BUG OF THE MONTH

PRENTISS FOR PEST-TESTED *Basic Insecticides*

The U. S. Department of Agriculture estimates that grubs of the ox-warble or heel fly cost the livestock industry from fifty to one hundred million dollars each year. In these times of meat and leather shortages it's just good business to control these grubs, and the one pest-tested insecticide is rotenone bearing powders used as either a dust or spray. Prentiss Cube Powder, batch mixed, assayed and standardized is an ideal basic insecticide for preparing insecticides for the control of the Heel Fly.

Other Prentiss basic insecticides include:

(1) Prentiss Micro-Mesh Dry—a 50% DDT powder for blending in agricultural dusts—milled to an average particle size of 2.5 microns.

(2) Prentiss Pyrethrum Powder — Finely ground and specifically adapted to agricultural dusts containing pyrethrum.

Look to Prentiss for a dependable source of supply on agricultural insecticide raw materials and intermediate products.

R. J. PRENTISS & COMPANY, INC.

110 William Street, New York 7, N. Y. 9 So. Clinton Street, Chicago 6, Illinois

Plants: Brooklyn, New York, and Newark, New Jersey

PRENTISS

RAW MATERIALS FOR AGRICULTURAL INSECTICIDES

NATIONWIDE TESTS NOW BEING MADE ON HERCULES'

TOXAPHENE

a new residual toxicant, formerly known as Hercules 3956

At about 75 locations throughout the nation, Federal, State, and private agencies have been testing Hercules Toxaphene in household, industrial, and agricultural insecticides.

Preliminary reports indicate that this new residual toxicant is highly effective against flies, moths, and roaches, as well as against cotton insects, the Mexican bean beetle, the tobacco horn worm, and other insects that plague the farmer.

Toxaphene, a chlorinated bycyclic terpene, will be available only in limited quantities over the next several months, and only for experimental work by qualified investigators.

To facilitate test work, Toxaphene is packed as (1) technical grade, (2) Thanite*-Toxaphene Concentrate, (3) 25% oil-soluble Toxaphene Concentrate, (4) 50% water-miscible Toxaphene Concentrate, (5) 25% wettable powder, and (6) 50% dust.

*Reg. U. S. Pat. Off.

HERCULES TOXAPHENE

Naval Stores Department *HERCULES POWDER COMPANY* INCORPORATED
970 Market Street, Wilmington 99, Del.

Please send me information on Toxaphene

Name.....

Title.....

Company.....

Street.....

City.....Zone.....State.....

NT-14